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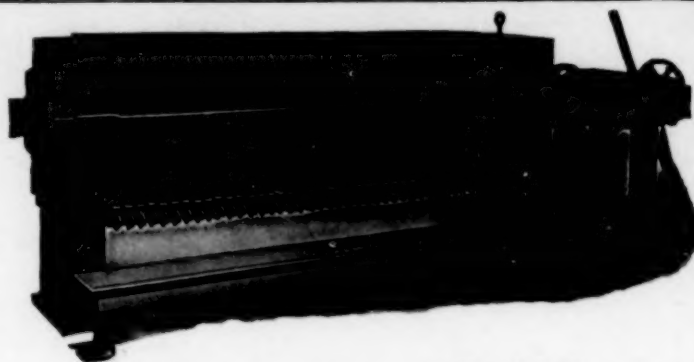
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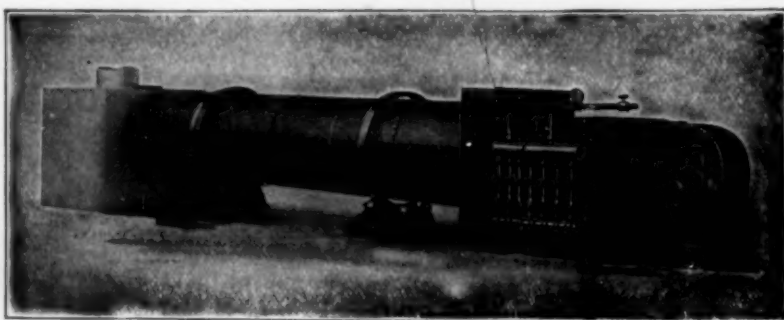
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CONTENTS for January 1, 1918

Volume XVIII, Number 1

EDITORIAL:

Important Developments in Nitrogen Fixation.....	1
Review of Gold and Silver Metallurgy.....	2
Metallurgy of Zinc in 1917.....	3
Copper Metallurgy in 1917.....	4
Flotation in 1917.....	5
Iron and Steel in 1917.....	6
The Western Metallurgical Field.....	8
The Webb Export-Trade Bill.....	10
United States Tariff Commission Making Inquiry in Regard to Chemical Industries.....	11
Attorney General Interprets Laws Bearing on Importation of Distilled Spirits.....	11
Suggestions for Conservation of Coal.....	12
A Correction.....	12
Council of National Defense Reorganized.....	12
Bureau of Standards Urges Use of Waste Pottery Bisque.....	13
Woman's Committee for Engineer Soldiers.....	13
Zinc Furnace Temperatures—II. By Edward Mackay Johnson.....	14
Recent Development of the Côte and Pierron Electric Zinc-Smelting Process.....	17
A Furnace for Testing Refractory Materials Under Load at High Temperatures. By Robert J. Montgomery.....	18
Disadvantages of Chrome Brick in Copper Reverberatory Furnaces.....	20
Our Resources. By G. W. Thompson.....	24
The Use of Cullm and Other Waste Materials from Coal-Washing Plants for Power Purposes. By John B. C. Kershaw.....	25
A Volume Regulator for Blast Furnace Engines. By L. C. Lowenstein.....	29
Bibliography on the Extraction of Potash from Complex Mineral Silicates such as Feldspar, Leucite and Glaucinite (Greensand Marl). By E. C. Buck.....	33
Synopsis of Recent Metallurgical and Chemical Literature.....	38
Recent Metallurgical and Chemical Patents.....	40
New Holder for Drawings and Blue Prints.....	43
Improved Quartz Mercury-Vapor Lamp for Ultra-Violet Light.....	43
Insulation Test on Steam Drums.....	44
Personal.....	45
Obituary.....	45
Book Reviews.....	45
The Chemical Market in the United States in 1917.....	46
Current Market Reports—Iron and Steel, Non-Ferrous Metal and Chemical Markets and Chemical Price List.....	50
Industrial—Financial, Construction and Manufacturers' News and Notes.....	54

Important Developments in Nitrogen Fixation

IT is now apparent that our requirements of ammonia and nitrates to be used in the manufacture of explosives for our army and navy have been greatly underestimated, and that the gravity of the situation which has been slowly but surely approaching has not been realized by the majority of the Government's advisers.

Important developments have recently taken place. In spite of the fact that our imports of Chile nitrate have increased enormously during the last two years—and our production of by-product coke ammonia has also increased to an enormous extent—the Government finds itself facing a serious shortage of ammonium nitrate. The Ordnance Department has consequently appointed the Air Nitrates Corporation its agent to construct and operate an immense plant at Muscle Shoals, Ala., to manufacture ammonium nitrate by the cyanamid nitrogen-fixation process. The arrangement is unique in Government affairs. The officers of the new company are at the head of the American Cyanamid Company and the services of that company's entire organization have been patriotically offered to the Government in connection with the project. Work is already under way on this new plant, which is entirely independent of the small plant now being built at Sheffield, Ala., to use the synthetic ammonia process recommended early in the fall by the Nitrate Supply Committee. Power will be obtained from the Alabama Power Company, pending the completion of the power plant, which is part of the hydroelectric development. In the meantime about 30,000 horse power will be supplied from the hydroelectric plant of the Alabama Power Company and 30,000 more from a steam plant now being constructed. Shipments are expected from the plant in six months.

It will be remembered that Congress appropriated \$20,000,000 in June, 1916, for nitrate supply. A Nitrate Supply Committee was later appointed by the Secretary of War to investigate various sources and processes of production of nitrates and nitric acid. We published the final recommendations of this committee a few months ago. They were, in brief, that a 30-ton per day synthetic ammonia plant should be constructed to use the General Chemical Company process and that an ammonia oxidation plant be constructed to produce 12 tons of nitric acid per day. Appropriations were also recommended for experimentation with other processes

M.S.T.

and it was recommended that 500,000 tons of Chile nitrate be accumulated as a reserve. Following these recommendations work was started on the synthetic ammonia plant, and is understood to be at present in progress. It is plainly evident now, however, that this source of supply in its present stage is not considered a very large factor by the War Department.

In studying the Nitrate Supply Committee recommendations one gets the impression very clearly that we had no urgent needs for nitrogen fixation, as considerable experimentation and development work was provided for and only \$3,600,000 out of the \$20,000,000 was to be spent at once in building plants for producing 10,000 tons per year of ammonia and about 4,000 tons per year of nitric acid. The cyanamid process was not mentioned in the final recommendations.

It will be remembered that Mr. Washburn, president of the American Cyanamid Company, offered in 1915 to build a \$30,000,000 plant on a suitable water-power site to make nitric acid for war needs and fertilizer in peace times. He had been requested by the War Department to present a scheme for nitrogen supply, and his ideas were published by us in April, 1916. Muscle Shoals was considered by many the ideal site for such a plant, and this dream is shortly to be realized. It was also very clearly brought out by Mr. Washburn that coke-oven ammonia could not be depended on to furnish us with ammonia for making nitric acid and nitrates in case of war. He showed that this ammonia was completely consumed in industries from which it could hardly be withdrawn without great damage in case of war (37 per cent is used in cold storage, 10 per cent in explosives and chemicals and the balance in fertilizers). We quote Mr. Washburn as follows:

Germany, the greatest European country in metallurgical industry, producing 90 per cent of her coke supply in by-product plants, turned to atmospheric nitrogen for her war requirements. . .

One of the serious limitations upon the growth of the by-product coke oven is the relatively great investment involved therein. (\$100,000,000 required to produce ammonia sufficient to make 180,000 tons of nitric acid per annum.) Notwithstanding these facts some enthusiasts have suggested that coke ovens could be erected wholesale in times of war.

These developments bring out two facts. First, that our needs have been greatly underestimated by the majority, and second, that in time of war quick action is needed and no time can be lost in experimentation or indulging in fascinating possibilities. The Government's decision does not discredit in the least the General Chemical Company's process nor the excellent work done by the Nitrate Supply Committee. It appears, however, that they greatly underestimated our needs and the necessity for quick action, and failed to recommend the use of the "bird in the hand," the cyanamid process, which had been thoroughly proved on an immense scale and was already well understood by American engineers. The reader is referred to Nauckhoff's article in our issue of Nov. 1, 1917, which shows the nitrogen resources of the warring nations very clearly and the part the cyanamid process plays.

It may be perfectly true that the synthetic ammonia process with subsequent oxidation of the ammonia to

nitric acid would be the most desirable from several standpoints in the long run, but many large-scale problems have yet to be met, and we have no time to wait. If the war continues any length of time we can use more than the output of both the synthetic ammonia and the cyanamid plants. Mr. Washburn estimated in 1916 that a plant such as is now being built at Muscle Shoals would produce the equivalent of 180,000 tons of nitric acid per year. We are not permitted at present to go into further details as to the Government's needs and the new plant, but we have very good reasons to believe that even this plant will be inadequate to meet our needs in a short time, so rapidly are they increasing.

Review of Gold and Silver Metallurgy

IT is now a year since we commented on the anomalous position of the gold producer in this era of advancing prices. More recent events have accentuated these conditions; doubly so, perhaps, because long-delayed prosperity came to the relief of the silver miner.

The high commodity prices and acute labor shortage prevalent throughout the world have borne heavily upon the gold miner, who, unable to recoup his expenditures by advancing the price of his own wares, has been at a disadvantage in competing in the labor market. Similar conditions are reflected in all our news from abroad, and Canada, Australia and South Africa are alike suffering from an insufficient supply of labor. T. T. Read recently summarized the situation in a pleasing phrase to the effect that we have passed from the position of buying labor to selling employment.

In such circumstances it is but natural that the past year has been marked by a singular lack of activity in the development of new processes and the erection of new plants. In general, it may be said that the metallurgist's attention has been engaged by collateral lines of activity rather than by those directly affecting his specialty, but always with their extension and future application in mind.

Thus his interest in grinding machinery and in flotation has continued. In a measure he has accepted the ball mill as standard practice, if we may so interpret the new mills at Oatman and the remodeling of the Dome plant. Parenthetically, it may be noted that ball mills crushing in cyanide solution and followed by fine-grinding machinery, Dorr counter-current decantation and Merrill precipitation equipment, constitute the modern plant. This flow-sheet indicates the discarding of amalgamation, and in such circumstances at least the ball mill seems to be the logical machine. Where amalgamation is to be retained in the scheme of treatment the matter is not so clear, since the "inside amalgamation" of the stamp mill cannot well be supplied to the ball mill by reason of difficulties of clean-up. It is our impression, however, that this objection need not be of serious import, since this "inside amalgamation" tends primarily, by its vigorous churning or mixing of quicksilver and pulp, to collect and amalgamate the extremely fine gold particles in the "slime" portion of the ore—the very particles that may be expected to yield most readily to secondary treatment.

There have been no radical changes in the mechanical equipment of the latest mills; the machines commonly in use for classifying and dewatering are, however, undergoing constant refinement. It is rather interesting to note that whereas mechanical classification is gradually supplanting hydraulic classification in gold and silver milling, a new design of cone, apparently a distant relative of the diaphragm cone of South African practice, is enjoying a certain popularity in the copper districts of the Southwest.

Extreme simplification of the flow-sheet may be leading us to unnecessarily fine grinding; separate treatment of sand and slime is no doubt more often justified than practised.

Flotation has progressed during the year, and in the direction indicated by an examination of its nature and limitations. At Cobalt and in the San Juan it has been of great value. It finds its best opportunity where, in addition to gold and silver, the ore contains sulphides or similar base-metal minerals in commercial quantity; it is least likely to win favor when its product must compete with high-grade bullion, salable to the government without discount. A chapter in Rickard and Ralston's recent book makes an interesting presentation of this phase of the process.

The method of cyanide production proposed by Bucher has attracted much attention. This process, it will be recalled, depends upon the reaction between carbon, sodium carbonate and nitrogen, at a temperature of 900 to 1000 deg. C., using finely divided metallic iron as a catalyzer. Clevenger has suggested what was no doubt in the minds of many others interested in gold extraction—that the cyanide so formed could be taken up at once in works solutions, thus obviating all concentration of the extract.

Bucher's process, unlike another chemical proposition which, a few years ago, gained much publicity in the technical press, lends itself to verification in the hands of others than its inventor. It makes cyanide, and the cyanide it makes, obtained in solution as Clevenger proposes, will extract gold.

Upon examination, it must be confessed that the proposed application loses some of its appeal. Certainly it would be a comfort to have a supply of cyanide always at command, but many an already overburdened millman might well demur to the assuming of one more duty. However this may be, we look for cheaper cyanide in the future, and we hope to see it offered by several new American manufacturers.

Indeed, the general development of America's chemical industries promises excellent things for the future. Zinc dust is now made at several American plants, production no doubt being stimulated by the prevailing prices, which have been firmer than the spelter market would seem to have warranted. The quality of some of these brands is most excellent, and it seems improbable that the German dust will ever command its earlier favor.

Simultaneously with improvement of the precipitant, the technique of precipitation has been refined and

developed. The former limitations of the process have undoubtedly been widened. Greater efficiency has been obtained and consequently a higher grade product is now the rule.

Zinc-dust precipitation was already dominant in this country. It will be interesting to observe whether the method will eventually replace the zinc-shaving process from its great stronghold in South Africa. It is conceivable that the sum of several minor improvements such as we have mentioned may finally throw the scale.

The many recent advances in the metallurgy of zinc are of especial interest to the cyanider, who requires the metal in his operations and must perforce tolerate it in his precipitates. In addition to the development of precipitation methods, we may see a revival of the proposal made some ten years ago—to distill the zinc from the precipitates, recovering it for further use.

It seems inevitable that improvements tending to increase the precious-metal content of precipitates will favor the introduction of the electric furnace for refining.

Metallurgy of Zinc in 1917

IT may be said that as zinc was the first metal to be affected by the war boom in metals, so it has been the first to be affected by the deflation consequent upon overproduction, and decrease of consumption due to artificially high prices. The end of the year 1916 saw a marked tendency in this direction. Production was even then already outstripping consumption, and profits were showing a corresponding depreciation. During 1917 the increasing cost of coal and gas fuel, together with the relatively higher cost of ore, has forced such a curtailment of output that at the end of this year we have a condition where only those plants having by-products of value, such as sulphuric acid, can show what even in pre-war days would have been considered a fair profit.

These remarks concerning commercial conditions are made only to call attention to the principal reason for what is apparently a lack of progress in zinc metallurgy during 1917. At a time when the less profitable plants are being shut down and when even the best plants are being forced to pass dividends, it is hardly to be expected that much new capital would be invested in improvements other than those absolutely necessary to meet the increased competition of the time.

The period of exorbitant profits during 1915 and 1916 has not been without its advantages, aside from the large returns paid by most of the smelting companies. New plants were constructed and older ones were enlarged and improved, and these improvements, in regions other than the gas belt, have been of such a character as the industry had not hitherto witnessed. In fact, most of the construction east of the Mississippi River is now such as to give great hopes for a commercially sounder basis for the industry, besides assuring relatively lower costs of production and better recoveries upon a return of normal conditions for labor and supplies.

As the year 1917 brought curtailment of smelter ca-

capacity instead of the expansion to which we had become accustomed, and brought even greater curtailment of profits to most of the smelting companies, so, as might be expected, improvements in the art have not been marked. Attempts have necessarily been made to meet higher labor costs with mechanical devices to increase the tonnage handled per man, and in minor items this has been more or less successfully accomplished.

Outside of the gas fields of Oklahoma and Kansas, practically all zinc sulphide ores are roasted with a special view to the conversion of the sulphur gas to sulphuric acid. For this purpose the roasting furnaces used in American practice have been almost invariably of the Hegeler type. Attempts have been made to introduce furnaces of the Spirlet or of the Wedge type, and such furnaces are, in some cases, in actual operation, but as yet there is no evidence of a desire on the part of operators in general to abandon the better established apparatus.

In the actual operation of the retort furnaces it would seem that there might be much room for labor-saving devices, especially in view of the increased cost of labor. In a few isolated cases mechanical devices for discharging and recharging the retorts are actually in use, and the operators of such devices seem pleased with the results obtained. But again it is to be noted that notwithstanding the present most favorable conditions their use is still confined to a very few plants, and most zinc metallurgists continue to look upon them as interesting experiments which may some day be worth investigating.

The metallurgy of zinc, as practised today in the older retort process, has been of slow growth, and is the result of many years' accumulated experience. The financial path of zinc metallurgy may be said to be marked by the tombstones of defunct processes. It has only been of recent years, especially since the metallurgist has been confronted by the necessity of smelting lower grade and more complex ores, that there have been any encouraging signs that new conditions might bring out new methods to meet them. The necessity for handling complex ores, low in zinc, especially those common in the Rocky Mountains, coupled with the abnormal demands for spelter of a great degree of purity which has accompanied the war conditions, has given the opportunity for the development of an entirely new process in zinc metallurgy.

Previous to the present year the production of electrolytic zinc had been measured in a few tons per day, and had taken place mostly on an experimental scale. During this year, however, the production of zinc by electrolysis may be said to have passed from the experimental to the commercial basis. The longest step taken, of course, has been that at Great Falls, although a number of other plants have come in with tonnages which, while much inferior to the output of Great Falls, are, nevertheless, of considerable magnitude.

It is, perhaps, too early yet to say just in what direction this new art will work out to the greatest advantage. The operations at Great Falls involve wet concentration of the ore to a high-grade product, followed

by roasting and leaching of the concentrate. This results in a residue containing a considerable amount of zinc, and attempts have been made to smelt this material in a reverberatory furnace, whereby the zinc is volatilized and a commercial quantity of the other metals collected in the form of a copper matte.

The work now being done on Colorado ores by another company, having an electrolytic refinery at Keokuk, Iowa, is carried out on lower grade and more complex ores. These are partly roasted, then smelted directly in a reverberatory furnace. By this means the lead and zinc are separated in a relatively pure form from the gangue of the ore, and the other metals are concentrated in a matte. The zinc and lead concentrates are then shipped to the refinery for separation.

The plant at Park City, Utah, follows, in general, the Great Falls practice of roasting and leaching, with the addition of revolving cathodes in the electrolytic tanks. The plant at Mammoth, California is operating on a complex baghouse product produced from the smelting of copper ores. This material has as its principal constituent zinc as sulphate, but has many other metals present, tending further to complicate an otherwise not simple process. The successful working out of this problem will reflect much credit on the men in technical charge of the work.

Direct electrothermal smelting of zinc ores seemed at one time to be approaching success. Much interesting and more or less successful work along this line was carried out at Hartford, Conn., a few years ago, but thus far the process has not come into commercial use. A plant is now being built by the Guggenheim interests at Pueblo, Col. In Norway, plants have been operating some years on such a method, but there the cost of power is lower than anything we have or are likely to have in this country.

Copper Metallurgy in 1917

GET the Copper" has been the slogan of the producers during 1917. During the first part of the year there seemed to be an unlimited market at very fancy prices—published quotations for spot metal ranged from 29 to 37 cents, then falling back to 25½ cents while the price-fixing program was awaited. Considerable copper changed hands at these figures, even though the bulk of the production was absorbed by the Allies at figures substantially lower, down to one large sale to the American government at about 16.7. The spot prices were evidently so excessive that the efforts of the administration were early turned toward fixing a price for the red metal, which was agreed upon Sept. 20, the official price being set at 23½ cents. This is a quite liberal figure, and one calculated to allow even the most unfavorably situated company to produce at a profit, although later many smiles were provoked by the attempts of brokers and other spokesmen to explain the profound riddle, "When is a low-cost producer, and why?"

The high price and scarcity of machinery and construction materials has not halted a universal extension in plant capacity. While only one notable new

smelter is under construction in the Western States—that of the United Verde Extension, building near Jerome, Ariz.—one can hardly mention a plant in that region which is not engaged in a construction program of considerable magnitude preparatory to a larger output of blister. One notable exception to this statement is the Great Falls plant of the Anaconda Copper Mining Company. Before the war broke out this smelter was one of the world's large copper producers. At the present time but little copper is made, and that merely as a by-product of their zinc plant, recently completed.

These efforts toward maximum production have been more than nullified, however, by an epidemic of labor troubles which seemed to infest the copper mines, smelters and refineries. Strikes of various degrees, intensity and duration spread from one location to another, completely paralyzing the activities of whole districts for as long as five months. These differences have now been largely settled—in some cases by a federal commission working apparently on some such theory as this: "The management and men must come together and resume production; the men will not compromise, therefore the management must."

The significant feature in reverberatory smelting is that oil is becoming too rare and valuable to be used as a fuel, and is to be supplanted by powdered coal. This change has already started. Side-charging of fettling or calcine through numerous holes at the skewback is almost universal. An interesting modification of this plan is that devised by Heggie, where manger-like openings through the side walls are constantly heaped with cold charge. This latter idea has brought about a most interesting and important evolution in buckstay construction, in fact, in the entire scheme of "ironing" a furnace.

In the converting department, the 13-ft. x 30-ft. Peirce-Smith converter mentioned in our review of last year, has amply demonstrated its efficiency, and is being installed in several American Smelting & Refining Company plants. This converter is structurally far superior to the smaller styles, and has established some enviable metallurgical records. Only the long-suffering converter crane-man could fully appreciate the clear air in the El Paso converter aisle, where some real hoods fit closely over the mouths of these new converters. Converter capacity has been materially increased by the common use of a silica gun. This device is merely an air-jet blowing a continuous stream of crushed siliceous material through the end of the converter during its operation. This saves the time of converter and crane necessary to charge this material by boat or chute; further, it facilitates uniform operation at a lower temperature, thus increasing the life of the basic lining. Everyone is still talking about that metallurgical nuisance, converter slag, but nothing new has been done about it. Multi-stage turbo-blowers, both of the Ingersoll-Rand and the Rateau-Bottu-Smoot design, are now quite common in power houses, replacing the bulky blowing engines used to compress converter air.

In copper hydrometallurgy, the successful operation of the New Cornelia plant at Ajo, Ariz., is a matter for congratulation to the metallurgists who worked out the possibilities of the process, and the capitalists who financed this new undertaking. A beautiful process and a beautiful plant! There is, however, one unsolved problem in these leaching processes, that is to say, the treatment of that very considerable percentage of solution which must be "bled" from the circulation to prevent undue accumulation of iron and other metallic impurities. At present the copper in the waste Ajo solution is precipitated on iron, but, as compared to the electrolytic room, these dirty vats seem extremely antiquated. In this connection it would be pertinent to point out that the price of iron scrap is steadily rising, while the prophesy that the easy production of sponge iron from concentrates will take first place as a precipitant seems yet to be fulfilled.

The general interest taken by copper metallurgists in their possible by-products is a good omen—even recent investigations on smelter smoke point to its value as an actual fertilizer. The general production of arsenic from flue dust in normal times served only to glut the market, but these plants are now working to capacity. Sulphuric acid plants are becoming so common as to fail to excite much interest. The old-school metallurgist, however, can hardly recognize that corner of the smelter where potash alum, zinc sulphate, zinc chloride or liquid sulphur dioxide is produced by the ton. Some few of the Western plants seem peculiarly well adapted for the production of brass munitions. Large quantities of electrolytic copper and zinc, ample coal and electricity, an energetic staff and adequate labor supply—this is a conjunction of factors, any one of which is becoming rarer in the Eastern States. In stress of war the past objections to this development, such as lack of market and high labor or freight rates, are either becoming less cogent or disappearing altogether. Eventually, of course, the West will absorb enormous quantities of locally-produced metallifera; the war may easily hasten the establishment of some of these factories close to the point of production. The construction of a rod-mill of considerable dimensions at Great Falls, Montana, seems an earnest of such near-by developments.

Flotation in 1917

THE interest in flotation has now passed its zenith and the process has become too common a thing to attract the interest that it did while young in its application to American conditions. For the past two years the various hydrometallurgical schemes have had to be set aside more or less to allow the full development of flotation before it was deemed safe to proceed with the more expensive hydrometallurgy. Interest is again beginning to center around the hydrometallurgy of copper, zinc and lead, in addition to the revival of older forms of the hydrometallurgy of silver and gold. The copper hydrometallurgists are reputed to have expected flotation to make leaching of copper from low-grade ores unnecessary, and were expecting to devote their

energy to the hydrometallurgy of flotation concentrate. It now seems certain that flotation will not be the complete solution of the treatment of low-grade oxidized copper ores, and that hydrometallurgy will come back to its own.

The various schemes for the flotation of oxidized minerals have been further tested and found wanting, for a number of reasons. In the first place, most of them are very likely to be spoiled by the appearance of ore of a slightly different composition than that for which they had been designed. For instance, it has been found that the oxidized ores of lead which can be sulphidized and floated are few in number, and that the great majority contain materials which consume the sodium or hydrogen sulphide used for sulphidizing. Such things as basic sulphate of iron or manganese dioxide are of common occurrence in oxidized ores, and tend to prevent good sulphidizing. So while there are undoubtedly a number of ores which can be successfully sulphidized and floated, the method does not present a universal solution of the problems involved. Probably methods will be found for neutralizing the "sulphidicides" just as they were slowly developed for neutralizing "cyanicides" during the growth of cyanidation.

The flotation-oils situation is no longer so acute, as it has been found that there is a great variety of oils which will yield acceptable flotation results, although the best ones are very hard to obtain. A number of scare-heads have appeared announcing the value of one or another nostrum for such work, but few of them have resulted in anything. Such has been the fate of shale oil and the products from destructive distillation of gilsonite and similar hydrocarbons.

Greater interest has centered around the various proposals which have been tested in attempting to escape the terms of the patents of the Minerals Separation Co. A number of the larger copper concentrating mills and one or two of the zinc mills began using more than 1 per cent of oil on the weight of the ore, 1 per cent having been said to be the approximate point below which a new effect was produced and for which the Minerals Separation Co. had been able to obtain patent. By the use of as high as 3 per cent of oil in commercial frothing-flotation work it seemed to be very definitely proved that there was no "critical proportion" of oil. This argument formed the basis of the defense in the new lawsuit brought by the Minerals Separation Co. against the Butte & Superior Co. in the Circuit Court at Butte. Nevertheless, the Minerals Separation Co. won the decision, and it has now been appealed and will shortly be tried in the higher court.

With regard to the patent situation, we have wearied of following its details. The stakes are too high for any of the parties involved to give up the fight, and the plaintiff company has changed front repeatedly in trying to claim the whole field of flotation. We have now lost all hope of a satisfactory end to this litigation, and think it not unlikely that the life of the patents will expire before the litigation ends.

Flotation is now in commercial operation in a number of mills for the concentration of molybdenum ores

in Canada and in Colorado. The details of its application apparently have been worked out to a satisfactory state for elemental sulphur, such as is found in low-grade sulphur ores, and for alumina resulting from the calcining and leaching of alunite ores in southern Utah. We do not know to just how many new uses the process will be put, but it seems safe to say that there will doubtless be more new applications as time goes on. Taken as a whole, we do not believe that the total tonnage of material treated by flotation processes will increase beyond the tonnage anticipated in 1918. There is a natural limit to everything, and advocates of flotation can well point with pride to the fact that the process is now being used on a greater tonnage of material than is any other metallurgical process outside of the concentration and smelting of iron ores.

Iron and Steel in 1917

THE iron and steel industry underwent startling changes during the year just closed, but in that it was true to character. The year opened with a continuance of the runaway market that had characterized the greater part of 1916, and when through Germany's declaration of ruthless destruction of merchant shipping on February 1 it became apparent that war was practically inevitable the market began to advance still more rapidly. The actual declaration of war on April 6 was followed by further advances, but the character of the market changed. It had long been realized that whenever the European war should end there would be a complete readjustment in iron and steel prices, while with the entrance of the United States into the war it was recognized that an advancing iron and steel market could not continue for an indefinite time. Buying for far-forward deliveries soon ceased, therefore, but that only left the prompt-delivery market freer to advance, and by the end of June a price-level had been reached that cast altogether in the shadow all previous market attainments. The prices at which sales were then being made were approximately double the average prices at which material was being shipped. It became obvious that buyers would be unable to pay these prices on the entire tonnage required. Some were making specialties that enabled them to pay almost any price. Others had relatively low-priced material being delivered to them, and paid the fancy prices only on such small tonnages that their average cost was not greatly increased.

On July 12 President Wilson made his famous appeal to miners and manufacturers that they should "forego unusual profits" and that there should be "one price for all," the Government, its Allies, and the general trade. The iron and steel trade did not seem to adopt the idea with much readiness. Apparently it was not gifted with its usual foresight, but there is reason to suppose that it foresaw the inevitable but could recognize no particular necessity for the existing trade being disturbed. The trade was running under such steam that it had a number of months still to go. Meanwhile no one would suffer particularly, and the Government intended to lay heavy war taxes upon

profits of the entire year 1917. In due time, namely on September 21, the iron and steel trade yielded gracefully to the President's requirements and then made it almost a religion to carry out the price agreement in both letter and spirit. There have been a few recalcitrants, but only a very few indeed. By agreement with the manufacturers, the War Industries Board announced on September 24, October 11 and November 5 certain prices for iron and steel products, while the price-setting for various other commodities was left to the American Iron and Steel Institute, with the understanding that all prices should be in harmony, considering costs, with the basis prices originally set.

The industry has found itself under obligation to furnish a great deal more iron and steel, for the best prosecution of the war, than was originally expected. The early estimates made, say from February 1 to July 1, all referred to material that would be required directly as war munitions for the Government and its Allies. These estimates ran, generally speaking, from 20 to 40 per cent of the output. Afterwards an altogether new viewpoint had to be developed. As President Wilson insisted in his appeal of July 12, although he did not mention any particular commodity, no clean distinction could be drawn between material required directly for war and material merely contributing more or less indirectly towards winning the war.

This fact became clear as to iron and steel. As the country from month to month reached a fuller realization of the industrial forces it would have to mobilize for prosecuting the war to the fullest extent, it was found that the few iron and steel-consuming industries that could not contribute were losing in activity of their own accord, while the great majority of the consuming industries could directly or indirectly aid in prosecuting war. Thus the capacity of the railroads was found to be strained, and more rolling stock, particularly locomotives, is obviously required. Maximum petroleum production is essential, requiring the fullest supply of oil-country tubular goods. The automobile factories, while consuming much less steel for making pleasure cars, are required to make many more trucks, in which heavier steel is used, as, for instance, light plates instead of blue annealed sheets. The one industry that seemed marked for decreased iron and steel consumption, without any compensating increase, the so-called building industry, has largely disappeared without leaving a gap, and yet it has had some special activity. The lettings of fabricated steel in November were heavier than in any of the eleven months preceding, and the lettings were almost entirely in connection with the war.

This complete change in the character of iron and steel activities occurred through the overriding of obstacles that had been considered difficult if not insurmountable. The iron and steel-consuming industries had been regarded as so specialized that only a limited portion of them could be employed for war activities. The iron and steel finishing departments were regarded as so specialized that they could convert only a limited proportion of the crude steel into forms suit-

able for war purposes. In both cases the specialization had to yield. Factories had to be converted to make war products instead of peace products, and the steel-finishing industry had to go through its own changes. The tradition was that the steel industry had to put such a percentage of its output into merchant bars, such a percentage into plates, and so on. The production in 1916 of sheared plates, $\frac{1}{4}$ in. and heavier, was only a trifle over 1,800,000 gross tons. Additional plate mills were built and the capacity approximately doubled. The slabbing mill output was entirely absorbed and a large tonnage of blooming-mill slabs is being employed. What has helped materially is that so large a tonnage of steel is required for shells, this steel being chiefly the product of the blooming mill, which thus becomes a general service mill. The supply of sheet bars has been somewhat limited, but the war requires the entire output of the tin mills only, and but a part of the sheet-mill output, and thus the end of 1917 found the tin mills operating full and the sheet mills operating at 50 to 60 per cent of capacity, with everyone moderately well satisfied.

At all times the iron and steel industry has been able to furnish all the iron and steel that could profitably be employed in the work of waging war. The changes required of the consuming industries have been occupying the time. It is a remarkable thing that when the steel industry has been so highly specialized it has been possible to respond so fully to the completely new alignment of demand. That it has been able to do so has been due to the fact that the consuming industries were likewise specialized, and had to undergo their changes.

The iron and steel industry is in position to furnish much more material than hitherto, if it is provided with adequate transportation facilities. It produced 39,400,000 tons of pig iron in 1916, operating its available furnaces practically at capacity, but at the close of 1917 it had capacity equal to 42,000,000 or 43,000,000 tons of pig iron, and had produced only about 38,750,000 tons in the year. There was, and is, a lack of sufficient transportation for Connellsville coke. In steel ingots the 1916 output was 41,400,000 tons and the 1917 output about 42,500,000 tons, but the capacity is nearly if not quite 50,000,000 tons. There have been shortages of pig iron, coal and scrap, due to insufficient transportation.

Taking only 45,000,000 tons as the ingot capacity of the United States, the Allies now have, with Canada, Japan, Italy, France and England, a total steel ingot capacity, actually operative, of close to 65,000,000 tons. The Central Powers started with about 19,000,000 tons in Germany and 4,000,000 tons in Austria, while Belgium's 2,500,000 tons capacity was captured and about 3,500,000 tons of the French capacity, making a total of about 29,000,000 tons, all of which cannot be operated. Steel will win the war, and the first American soldier to give his life on the western line was in the Minette iron-ore district, with the great French and German steel-producing districts before him.

ing to the ideas of James Heggie, general superintendent of the El Paso plant of the A. S. & R. Co. This involved piercing the side walls with broad, arched openings, requiring a buckstay-spacing of about nine feet—the thrust of the roof arch being carried by a heavy horizontal girder.

This construction proved to be satisfactory in all respects, and the third reverberatory was accordingly ironed in a similar manner throughout its length, replacing the multitude of small I-beam buckstays by the largest H-beams, in combination with horizontal girders behind the skew-backs to carry the roof thrust. At the same time the arch was carried full width to the skimming end of the furnace, avoiding excessive scour on the bricks at this region.

The objection to this ironing is that it is hardly flexible enough. That is to say, in case of a failure of a portion of the arch between expansion joints, it is almost impossible to regulate the movement of the new section without large and undue distortions in the old roof. This has been corrected by the superintendent, Mr. R. B. GREEN, in the reverberatory now being built by placing a pair of buckstays opposite each expansion joint in the roof and subdividing the horizontal girder so that each section of the roof can be handled as a unit. With such construction a roof-failure can be replaced in a few hours and the furnace again smelting in the time formerly required to cool off the whole furnace.

Although the present reverberatories are oil-fired, the management has decided to replace this fuel with pulverized coal, owing to the increasing price and scarcity of oil. Construction of a 300-ton pulverizing plant has therefore been commenced.

The converter department has seen a corresponding increase in capacity. Originally containing two 10 ft. by 26 ft. Pierce-Smith shells, a 12-ft. Great Falls converter was soon installed to act as a standby. Construction of a large 13 ft. by 30 ft. Pierce-Smith is now under way to care for the matte produced by the added furnace capacity. The brick converter flue, 18 ft. 1 in. by 19 ft. 6 in., in cross-section (hopper-bottomed), will be extended south to a point of higher ground, where a new concrete stack 16 ft. diameter by 250 ft. high, will be built. This will replace the present temporary stack, a square steel skeleton lined with corrugated iron.

When these additions are completed, which will be about July 1, 1918, the Hayden smelter will smelt approximately 2000 tons of charge daily and ship a monthly production of 10,000,000 pounds of blister copper.

De Spirlet Kilns at Argentine, Kans.

The National Zinc Company has been operating zinc blende roasters of the De Spirlet type for about two years, and at the present time has a battery of ten of these kilns in operation. As has been noted in METALLURGICAL & CHEMICAL ENGINEERING, Sept. 1, 1917, page 220, these roasters consist of a succession of round superposed, flat arches, which are alternately fixed or rotating. Rabbling is effected by fire-clay blocks projecting from the roof of the individual hearths. Thus, the top arch forms the roof of the top hearth, and is stationary. The next arch rotates and forms the floor

of the top hearth and the roof of the next-to-top hearth; the next is stationary, and so on.

The hearths themselves, 12 ft. 10 in. in diameter, are built within a ring of suitable steel shapes. This ring is placed on a floor and a centering of sand swept up using the familiar pivot and sweep of the loam mold. The bricks, 5 in. thick, are all special, with a key extending around the edges. It has been found that extreme care in matching these bricks for a minimum clearance at the joints will prolong the furnace campaign from four months to a life of one year. Four brick masons complete an arch in three days.

An annular trough of bent angles is riveted to the periphery of these flat arches, which is filled with roasted ore and acts as a seal. Into the channel filled with granular material projects the downstanding leg of another bent angle riveted to the bottom of the corresponding channel just above. This sand seal effectually closes the joint between fixed and moving hearth. The fixed arches are hung from brackets at four columns.

These same brackets each carry a flanged wheel upon which the moving arches rotate. The track consists of the side of a bent railroad rail, to the base of which are bolted segments of a gear, meshing into a motor-driven pinion at one column. The individual arches are assembled into a furnace by traveling crane.

The hearths themselves are quite shallow, hardly 12 in., top to top; while the rabbles clear the bed only $1\frac{1}{4}$ in. The top hearth acts mostly as a dust chamber, the SO_2 gases being drawn off into collecting flues at the periphery. The ore is automatically charged near the center of the stationary roof and soon is worked through a hole at the center of the rotating bed. The rabbles of the second hearth work the ore toward the periphery, dropping to the bed below, thence to the center, and finally into two hoppers at the edge of the bottom hearth.

The base of this hearth forms the roof of a similar muffle which is heated by a coal flame, the products of combustion being drawn downward through ribbed iron flues to a chimney opening. Air for the roasting of the ore is preheated by being circulated around the cast-iron chimney flues and thence through a muffle just below the combustion chamber. The hot air is then introduced into the drop hole of the lowest ore hearth, and travels in a direction opposite to that of the ore. The SO_2 content of the gases is remarkably uniform, standing at 7 per cent \pm 0.5 per cent for hours together. Dusting is extremely low, being only about 4 per cent when working on flotation concentrates. A treater is being installed to precipitate all of this finest dust, in order to clarify the acid made from the smoke. The recovered flue dust is converted into zinc sulphate.

One man tends the three furnaces, his only duties being carefully to loosen accretions from the fireclay rabbles from time to time. Coal consumption is 1 ton \pm per furnace. Each furnace treats about 7800 lb. of green ore plus about 1800 lb. spiles, this being average capacity for a full campaign.

The engineers of the National Zinc Company have changed many features of the original De Spirlet design, and feel that real progress has thus been made. They are still experimenting on the furnaces to determine the characteristics best fitted for each individual ore at their disposal.

The Webb Export-Trade Bill.

AN important measure in Congressional legislation looking toward the establishment of American export trade is known as the Webb bill. It has passed both House and Senate, and it is expected that a Conference Committee will reach an agreement on minor differences when Congress reconvenes Jan. 3. The measure is so vital to American trade that we publish it herewith, with the Senate amendments numbered and italicized. The portions stricken by the Senate amendments are enclosed in brackets.

AN ACT

To promote export trade, and for other purposes:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

That the words "export trade" wherever used in this Act mean solely trade or commerce in goods, wares, or merchandise exported, or in the course of being exported from the United States or any Territory thereof to any foreign nation; but the words "export trade" shall not be deemed to include the production, manufacture, or selling for consumption (1) *or for resale*, within the United States or any Territory thereof (2), of such goods, wares, or merchandise, or any act in the course of such production (3) [or] manufacture (4), *or selling for consumption or resale*.

That the words "trade within the United States" wherever used in this Act mean trade or commerce among the several States or in any Territory of the United States, or in the District of Columbia, or between any such Territory and another, or between any such Territory or Territories and any State or States or the District of Columbia, or between the District of Columbia and any State or States.

That the word "association" wherever used in this Act means any corporation or combination, by contract or otherwise, of two or more persons, partnerships, or corporations.

Sec. 2. That nothing contained in the Act entitled "An Act to protect trade and commerce against unlawful restraints and monopolies," approved July second, eighteen hundred and ninety, shall be construed as declaring to be illegal an association entered into for the sole purpose of engaging in export trade and actually engaged solely in such export trade, or an agreement made or act done in the course of export trade by such association, provided such association, agreement, or act is not in restraint of trade within the United States, and is not in restraint of the export trade of any domestic competitor of such association.

And provided further, That such association does not, either in the United States or elsewhere, enter into any agreement, understanding, or conspiracy, or do any act which artificially or (5) [intentionally and unduly] *the natural effect of which enhances* (6) *or depresses* prices within the United States of commodities of the class exported by such association.

Sec. 3. That nothing contained in section seven of the Act entitled "An Act to supplement existing laws against unlawful restraints and monopolies, and for other purposes," approved October fifteenth, nineteen hundred and fourteen, shall be construed to forbid the acquisition or ownership by any corporation of the

whole or any part of the stock or other capital of any corporation organized solely for the purpose of engaging in export trade, and actually engaged solely in such export trade, unless the effect of such acquisition or ownership may be to restrain trade or substantially lessen competition within the United States.

Sec. 4. That the prohibition against "unfair methods of competition" and the remedies provided for enforcing said prohibition contained in the Act entitled "An Act to create a Federal Trade Commission, to define its powers and duties, and for other purposes," approved September twenty-sixth, nineteen hundred and fourteen, shall be construed as extending to unfair methods of competition used in export trade against competitors engaged in export trade, even though the acts constituting such unfair methods are done without the territorial jurisdiction of the United States.

Sec. 5. That every association now engaged solely in export trade, within sixty days after the passage of this Act, and every association entered into hereafter which engages solely in export trade, within thirty days after its creation, shall file with the Federal Trade Commission a verified written statement setting forth the location of its offices or places of business and the name and addresses of all its officers and of all its stockholders or members, and if a corporation, a copy of its certificate or articles of incorporation and by-laws, and if unincorporated, a copy of its articles or contract of association, and on the first day of January of each year thereafter it shall make a like statement of the location of its offices or places of business and the names and addresses of all its officers and of all its stockholders or members and of all amendments to and changes in its articles or certificate of incorporation or in its articles or contract of association. It shall also furnish to the commission such information as the commission may require as to its organization, business, conduct, practices, management, and relation to other associations, corporations, partnerships, and individuals. Any association which shall fail so to do shall not have the benefit of the provisions of section two and section three of this Act, and it shall also forfeit to the United States the sum of \$100 for each and every day of the continuance of such failure, which forfeiture shall be payable into the Treasury of the United States, and shall be recoverable in a civil suit in the name of the United States brought in the district where the association has its principal office, or in any district in which it shall do business. It shall be the duty of the various district attorneys, under the direction of the Attorney General of the United States, to prosecute for the recovery of the forfeiture. The costs and expenses of such prosecution shall be paid out of the appropriation for the expenses of the courts of the United States.

Whenever the Federal Trade Commission shall have reason to believe that an association or any agreement made or act done by such association is in restraint of trade within the United States or in restraint of the export trade of any domestic competitor of such association, or that an association either in the United States or elsewhere has entered into any agreement, understanding, or conspiracy, or done any act which artificially or intentionally and unduly (7) [affects] *enhances or depresses* prices within the United States of commodities of the class exported by such associa-

tion, it shall summon such association, its officers, and agents to appear before it, and thereafter conduct an investigation into the alleged violations of law. Upon investigation, if it shall conclude that the law has been violated, it may make to such association recommendations for the readjustment of its (8) [business, in order that it may thereafter maintain its organization and management and conduct its business in accordance with law] *organization, business, conduct, practices, or management in order that they may comply with the law*. If such association fails to comply with the recommendations of the Federal Trade Commission, said commission shall refer its findings and recommendations to the Attorney General of the United States for such action thereon as he may deem proper.

For the purpose of enforcing these provisions the Federal Trade Commission shall have all the powers, so far as applicable, given it in "An Act to create a Federal Trade Commission, to define its powers and duties, and for other purposes."

Passed the House of Representatives June 13, 1917.

Attest: SOUTH TRIMBLE,
Clerk.

Passed the Senate with amendments Dec. 12, 1917.

Attest: JAMES M. BAKER,
Secretary.

United States Tariff Commission Making Inquiry in Regard to Chemical Industries

The Tariff Commission is undertaking an inquiry into the significant developments that have taken place in the chemical industries since the passage of the tariff act of 1913. Changes which seem likely to alter permanently the conditions of international competition or the course or volume of foreign trade are to be special subjects of study.

All persons having direct knowledge of pertinent facts in regard to any particular industry or product are invited to submit a statement to the Tariff Commission. Among the matters on which the Commission desires as full and complete information as possible are:

1. The manufacture within the United States of articles formerly unavailable or obtained exclusively by importation, for example, phosgene.
2. In the case of industries previously established in the United States, the erection of new plants or increase in capacity of existing plants; for example, the increase in capacity of existing plants for making caustic soda and chlorine and the installation of such plants as textile and paper mills.
3. The future of industries or establishments newly created, or in which productive capacity has been greatly increased to meet a direct war demand. How can these plants be utilized when the war demand disappears? For example, the acetone industry.
4. Any general or significant differences in the prevailing method of manufacture in the United States and abroad, such as the relatively small use of the carburetted water-gas process in England compared to the process in the United States.
5. Differences in the organization of the industry in the United States and abroad.
6. The development or invention in the United States

or abroad of new or improved processes which are likely to influence the conditions of international competition; for example, the hydrogenation of fatty oils or the flotation process for concentrating ores.

7. Significant changes in the conditions of international competition caused by the recent law making patents owned by citizens of enemy countries available to American manufacturers; for example, the patents on salvarsan.

8. Industries which have been seriously hampered in their normal operations or in their development by difficulty in securing materials or supplies formerly imported; for example, the lack of potash for fertilizer or glass. If these difficulties have been met by the introduction of substitutes, is it expected that there will be a return to the old materials and methods when foreign supplies again become available, or will the changes be permanent?

9. Developments or changes in other industries which have created a new or greatly increased demand for chemical products; for example, the manufacture of new varieties of glass in the United States.

10. The discovery of new uses of materials, creating a new demand or furnishing a market for materials formerly wasted; for example, the use of aniline as an accelerator in the vulcanization of rubber.

11. Any governmental hindrances in the United States or abroad, either in manufacture or commerce; such as the export duty on nitrate from Chile.

The Commission will publish only general statements or summaries, which will not reveal the operation or plans of individual companies.

Attorney General Interprets Laws Bearing on Importation of Distilled Spirits

In response to a request from the Secretary of the Treasury, the Attorney General has given an interpretation of the recent legislation on importation of distilled spirits. The food control act approved August 10, 1917, states: "Nor shall there be imported into the United States any distilled spirits." The revenue act approved Oct. 3, 1917, provides:

"That no distilled spirits produced after the passage of this act shall be imported into the United States from any foreign country, or from the West Indian Islands recently acquired from Denmark (unless produced from products the growth of such islands, and not then into any state or territory or district of United States in which the manufacture or sale of intoxicating liquor is prohibited), or from Porto Rico or the Philippine Islands. Under such rules, regulations and bonds as the Secretary of the Treasury may prescribe, the provisions of this section shall not apply to distilled spirits imported for other than (1) beverage purposes or (2) use in the manufacture or production of any article used or intended for use as a beverage."

The question is: To what extent, if any, does the latter act repeal the earlier?

In answer to this question the Attorney General has given the following opinion:

1. Distilled spirits produced before the passage of the war-revenue act may not be imported for beverage purposes.
2. Distilled spirits produced before the passage of the

war-revenue act may not be imported for any purpose.

3. Distilled spirits produced after the passage of the war-revenue act may be imported for other than beverage purposes and under such rules, regulations and bonds as the Secretary of the Treasury may prescribe.

4. Distilled spirits produced in the West Indian Islands recently acquired from Denmark, if produced from products the growth of the islands and produced after the passage of the war-revenue act, may be imported for any purpose, but if produced before the passage of the war-revenue act their importation for any purpose is prohibited.

Suggestions for Conservation of Coal

Owing to the difficulty of securing customary supplies of coal it becomes necessary to run existing steam power plant with the greatest possible economy. Owners and managers are urged to investigate their power costs and increase efficiency where possible. The Committee on Coal Conservation of the Chamber of Commerce of the United States makes the following suggestions:

Reconsider the advantage of buying heat and power from a specialized plant. In some localities hydroelectric power may be available.

Find the nearest source of coal that will meet the requirements, as this will relieve the tax on our transportation system.

Give to the power plant and its personnel the recognition and encouragement due to an expert and important department. Seek to increase skill and proficiency in the men who handle the coal.

Put the fuel-using equipment into as perfect condition as possible; eliminate leaks in the boiler setting and see that the firedoors fit well. Install simple means by which the fireroom force may see improved results.

Run boilers at capacity, use water free from scale-forming substances, and reduce loss of heat after it is generated by insulating boiler and pipe surfaces.

One pound of coal per hour has yielded a horsepower per hour. That is the record of present possibility. It cannot by any manner of means be attained by every plant. But the fact that at present the average attainment throughout the country is but one-third or one-fourth of this record is indicative of the possible savings that can be made if the care and attention which the power plant deserves are actually given to it.

A Correction

In our issue for Dec. 1, 1917, page 631, Mr. M. Luckiesh contributed an article on "The Physical Basis of Color Technology." Through an inadvertence he did not receive galley proof for correction, and as a consequence the mathematical equations contained a number of errors. We reproduce the equations herewith in correct form to supersede those appearing on page 636 of the issue mentioned:

$$(1) \quad J = J_0 e^{-kd}$$

$$(2) \quad \log \frac{J}{J_0} = \log T_L = -k_L d \log e = -\epsilon_L d$$

$$(3) \quad J = J_0 A_L^{cd} \text{ or } T_L = A_L^{cd} \text{ or } \log T_L = cd \log A_L$$

Similar reference characters appearing in the accompanying text should be corrected accordingly.

Council of National Defense Reorganized

On account of the fact that the food control bill provides that corporations whose officials serve on advisory committees are not allowed to enter into contracts with the Government, the Council of National Defense has completed plans for reorganization. Under the new plan prominent industrial men will sever their connections with their industries and go into Government employ, and separate committees will be appointed by the industries themselves. The following statement was issued Dec. 7 by the Council of National Defense.

"The Council of National Defense was established to bring about the co-ordination of industries and resources for the national security and welfare. Previous to the entrance of this country into the war steps were taken by the Council so to mobilize the industries of the country that they could render effective assistance to the nation in its hour of need. The crisis made imperative the necessity for prompt action. Many industries had not been organized in time of peace so as effectively to aid the country in time of war. For these industries to organize themselves, lacking a clear understanding of what the Government would need from them in the emergency, involved delay. Since instant steps were necessary, the Council of National Defense authorized the formation, under its direction, of co-operative committees of industry to be composed of men representative of their respective lines. No other machinery existed or could have been created at that time for the accomplishment of the vital tasks at hand, which primarily were to carry the country through the transition period from peace to war.

"These committees have given faithful, patriotic and invaluable assistance to their country. Many of the individuals serving on them have done so only at great personal and financial sacrifice. The thanks of the entire country is due to these men who unhesitatingly and unselfishly responded to the Government's appeal for aid.

"Technically, however, this necessary emergency machinery set up by the Council was not in the administrative sense ideal as a means for making permanent the mobilization of industry in a democracy at war. Practically it was effective, but the committees were placed before the public in a position unfair both to themselves and to the Government. The Council and its War Industries Board, after giving this matter serious thought for some weeks, have concluded that it is now possible to arrange for meeting the Government's needs through the appointment of highly qualified individuals as Government employees and expert advisers, and also to meet the needs of industry as well as to assist the Government by representative committees created not by the Government but by the industries themselves.

"It therefore has become feasible to discontinue the embarrassing situation wherein the members of the present committees are apparently called upon to act both as Government agents or advisers and at the same time as representatives of the industries. In dissolving the present co-operative committees of industry, which were appointed by and under the direction of the Council, the action is taken only with the highest praise and thanks for their splendid and indispensable work and at the same time with the hope that representative committees of the industry will be formed by the industries themselves at the earliest possible moment. The establishment of such committees, formed so as to entitle them to speak for their entire industries, will render immediately available valuable sources of information upon which the Government can draw in connection with the countless business and industrial problems attendant upon the conduct of the work necessary for the prosecution of the war.

Bernard M. Baruch will remain as commissioner of the raw materials section, which will be divided as follows:

Explosives, chemicals, etc.—L. L. Summers, L. L. Summers & Co., New York.

Nonferrous metals and cement—Eugene Meyer, Jr., New York.

Steel—J. L. Replogle, American Vanadium Company, New York.

Oil—J. F. Guffey, the Philadelphia Company, Pittsburgh.

Bureau of Standards Urges Use of Waste Pottery Bisque

From a circular letter sent by the Pittsburgh Laboratory to makers of glass pots, and others, we give the following extract:

"In work conducted at the Pittsburgh laboratory it has been found that the waste bisque of whiteware potteries is well adapted for use as 'grog' for pots used in the melting of optical glass so urgently needed at the present time for range-finders, gun sights, periscope lenses, etc. The low content of iron oxide in this material and its homogeneous structure render it superior to the crushed pot shell or calcined clay for this specific purpose. A much smaller and limited amount of porcelain bisque may also be used, but it is very important to keep the different kinds of body sharply separated, since porcelain tableware bisque is distinct from floor tile, electrical and sanitary porcelain. The porcelain can be used only in small quantities as a fluxing constituent, while the typical whiteware body is of a refractory nature. It is evident that glazed pottery waste cannot be used, and that we are speaking here of unglazed material. It is estimated that close to 250 tons of whiteware bisque are available per month at the present time, and at a very reasonable price. Appeals to a number of large pottery manufacturers have been answered with most gratifying promptness, which speaks well for their zeal for the common good.

"The whiteware bisque is well suited also for use in the regular glass-pot mixtures, but preference should be given to pots used in the melting of optical or signal glass. The whiteware bisque most suitable for this purpose should have a softening point corresponding to Orton cone No. 30 or above.

"In being employed for this purpose, the bisque is crushed in a jaw crusher or dry pan, screened, and then passed over a magnetic separator for the elimination of metallic iron.

"The Pittsburgh laboratory is ready to give advice concerning the supply and use of this waste material to any one interested, and is ready to make softening point determinations free of charge. Inquiries should be addressed to the Bureau of Standards, Fortieth and Butler Streets, Pittsburgh, Pa."

Industrial Service Section of the Council of National Defense

The Council of National Defense has issued the following statement:

As the demands of the Government for more supplies of all sorts have increased there have necessarily arisen in the various departments placing war orders a considerable number of problems relative to proper adjustment of labor supply to the war needs.

In order to secure a basis of facts on which to work out policies, the Council of National Defense has authorized the director to undertake the following work:

1. To determine present and probable future demands for labor in war industries.
2. To determine in connection with the priorities committee of the War Industries Board the relative priorities of the labor demand.
3. To arrange for the supplying of the demand through the Department of Labor or such other gov-

ernmental or civilian agencies as can best meet the demand.

4. To determine the needs for dilution of labor, including the introduction of women into industry and recommend policies to be followed in regard thereto.

This work under the council has been put under the immediate charge of Mr. L. C. Marshall, who is designated chief of the section on industrial service. Mr. Marshall comes to this work from the deanship of the School of Commerce and Administration of the University of Chicago. He has given his time recently to the special consideration of labor matters as affecting certain procurement divisions of the War Department, and thus takes up the new work with broad general information and special detailed knowledge of a number of the more pressing problems.

It is not contemplated that there will be created under the council any agencies for executive action with respect to the problems concerned. The purpose is to have under the council a section to which these various labor problems may be brought for common consideration.

The new section will work in close co-operation with the War Industries Board and its priorities committee and will, like the War Industries Board, bring to the council digested information from all Government departments as to the above subjects. Policies can then be worked out to secure the most efficient utilization of existing agencies and to facilitate the development of such new agencies as may be necessary.

Woman's Committee for Engineer Soldiers

An organization known as the Woman's Committee for Engineer Soldiers has been formed in Washington, D. C., with Mrs. Wm. M. Black, wife of General Black, Chief of Engineers, as president, Mrs. Charles Keller vice-president and chairman, Mrs. W. W. Harts secretary, and Mrs. Ulysses Grant, 3d, treasurer.

The object of the Woman's Committee is to see that no engineer soldier leaves this country without the proper knitted garments and to send garments to those already "over there." The National Committee in Washington is to be headquarters for units all over the country, and by purchasing yarn in large wholesale quantities should be able to get better prices and deliveries.

An earnest appeal is made to every man and woman interested in the engineers of the Regular Army, National Army, the Railroad, Forestry, Camouflage, or Labor regiments, to join this organization or to send contributions of money for wool, or finished knitted garments, to supply these hundred thousand men. Dues for membership, amounting to one dollar per year, may be sent to Mrs. Wm. M. Black, 1730 I Street, N. W., or Mrs. Ulysses Grant, 3d, 2204 R Street, N. W., Washington, D. C.

The Allied Purchasing Commission is now located in the new and temporary structure housing the Council of National Defense at Eighteenth and D Streets, Washington, D. C. Manufacturers who are producing or who believe their plants are in a position to produce supplies needed by the Allied Governments should make known this fact to the Allied Purchasing Commission.

Zinc Furnace Temperatures—II

Temperatures of Regenerative Furnaces

BY EDWARD MACKAY JOHNSON

Superintendent Eagle-Picher Lead Co.

CONTINUING the data on furnace temperatures given in METALLURGICAL AND CHEMICAL ENGINEERING Sept. 15, 1917, page 300, I present the accompanying curves plotted from temperatures taken on the furnaces in the checker work during periods of reversing, the first reading being taken just before reversing.

Bristol couples were used. In each case they were inserted the same distance into the checker work ports and luted up with clay. Four couples were used at the same time, with leads to one switch common to all. By this means it was possible to take four readings almost simultaneously. The following explanation of the curve numbers holds good for all curves.

If on long valve, E. or W. side:

- No. 1. Top outside checker, gas entering laboratory.
- No. 2. Top inside checker, air entering laboratory.
- No. 3. Bottom outside checker, gas entering checkerwork.

- No. 4. Bottom inside checker, air entering checkerwork.
- No. 5. Top outside checker, gases of combustion leaving laboratory of furnace.
- No. 6. Top inside checker, gases of combustion leaving laboratory of furnace.
- No. 7. Bottom outside checker, gases of combustion leaving checkerwork of furnace.
- No. 8. Bottom inside checker, gases of combustion leaving checkerwork of furnace.

Example A: Chart G, furnace No. 4, long valve, east side: Curve No. 1 represents the gas entering the top of the outside checker, and during a period of 20 minutes shows a drop of 65 deg. C. Now upon reversing, No. 5 curve represents this particular spot and shows an increase of 75 deg. C. due to the effect of the hot gases of combustion leaving the furnace.

Example B: Referring to the same chart, consider curve No. 2. This curve represents the air entering the top inside checker and during a period of 20 minutes shows a drop of 105 deg. C. Now upon reversing,

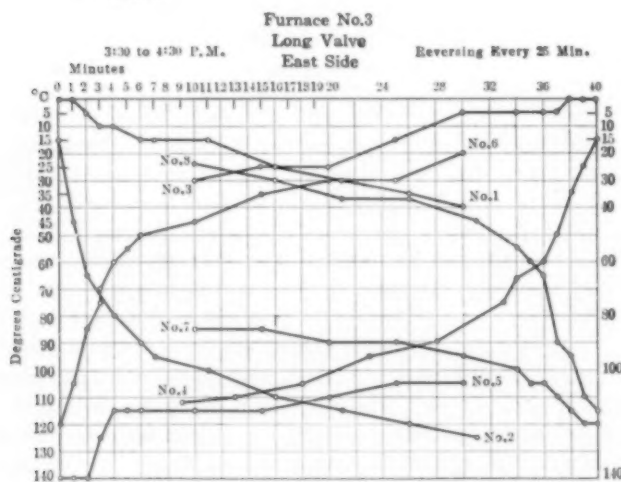


CHART A

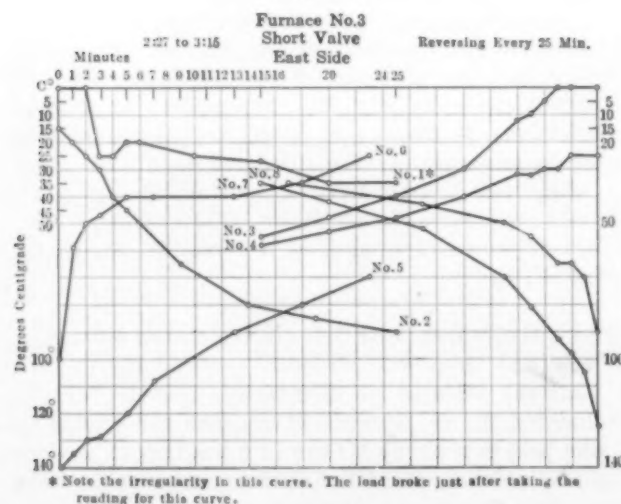


CHART C

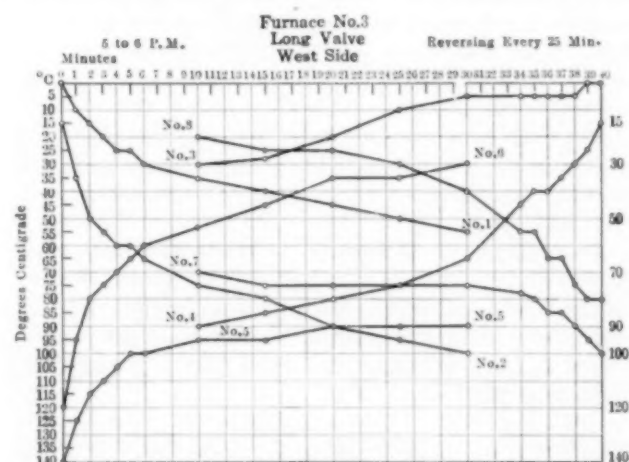


CHART B

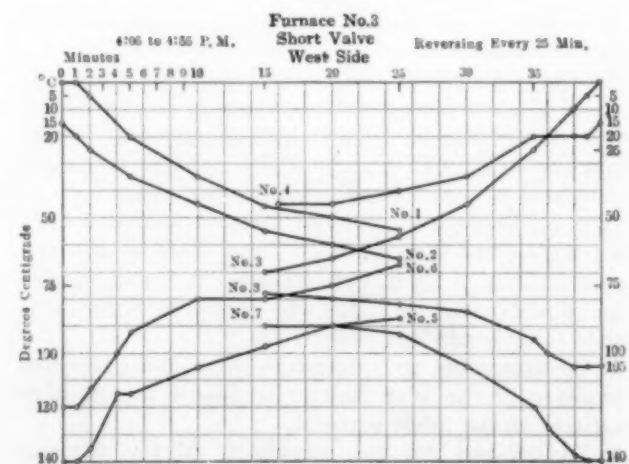


CHART D

* Note the irregularity in this curve. The load broke just after taking the reading for this curve.

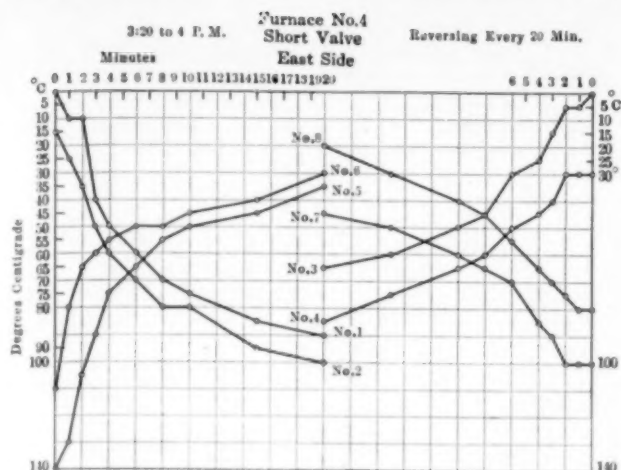


CHART E

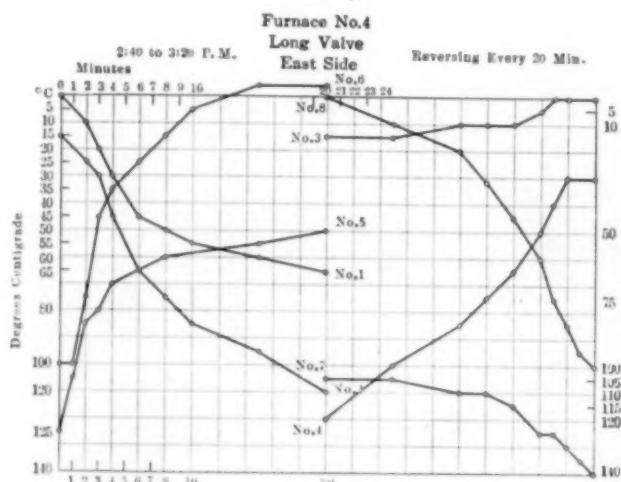


CHART G

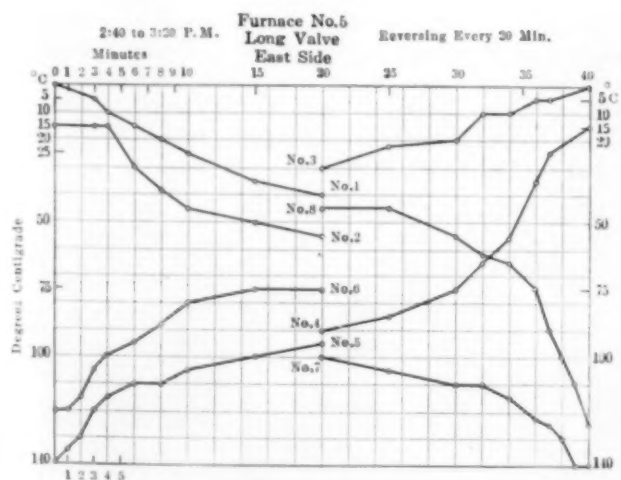


CHART I

No. 6 curve represents this particular spot and shows an increase of 105 deg. C. due to the effect of the hot gases of combustion leaving the furnace.

In the same way comparisons may be drawn between curves 3 and 7, and 4 and 8.

Various other comparisons may be made from the curves: As between the long and short valve or between east side and west side, also between inside and outside checkers, from all of which conclusions may be drawn relative to the construction of the checker-work

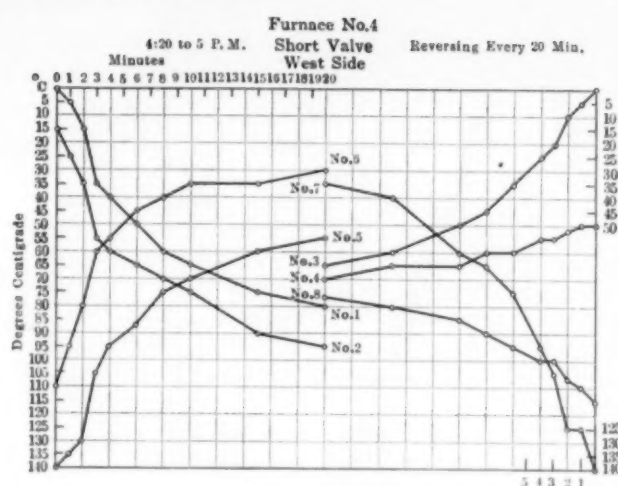


CHART F

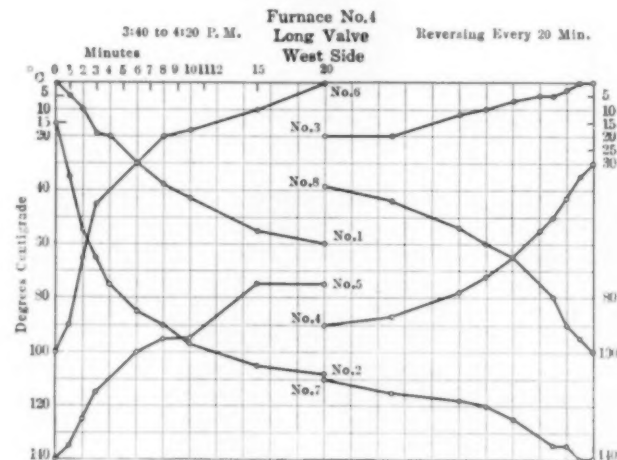


CHART H

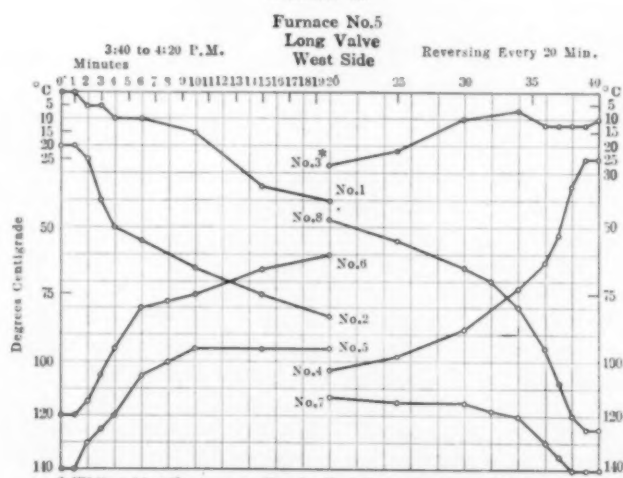


CHART J

* While taking the temp. reading for No. 3 Curve the mason had a brick out doing some work on end wall which permitted air to enter and burn the gas in the checker work. Hence the irregularity of curve.

walls, or the height of the checker, or the periods of reversing.

TEMPERATURE OF GASES ENTERING STACK

Temperatures taken in the four channels between the valve boxes and the furnace showing a comparison of results during a period of reversals of the gas or air entering on the east side and leaving on the west side, and vice versa, are given in the accompanying tables.

In taking the readings four Bristol pyrometers in-

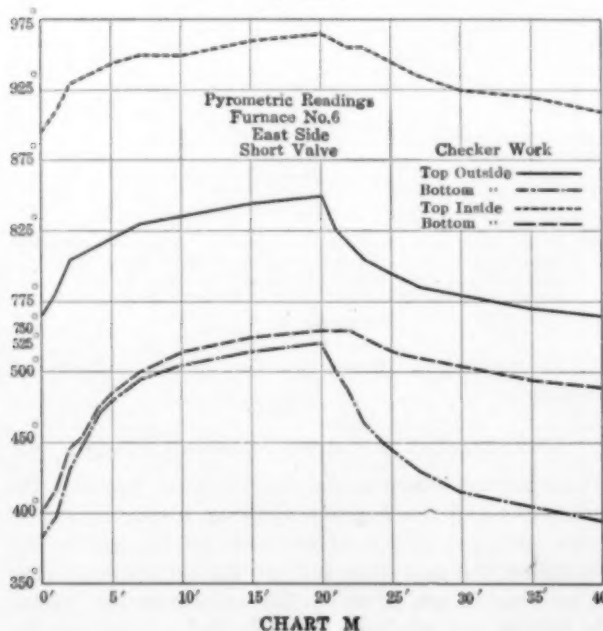
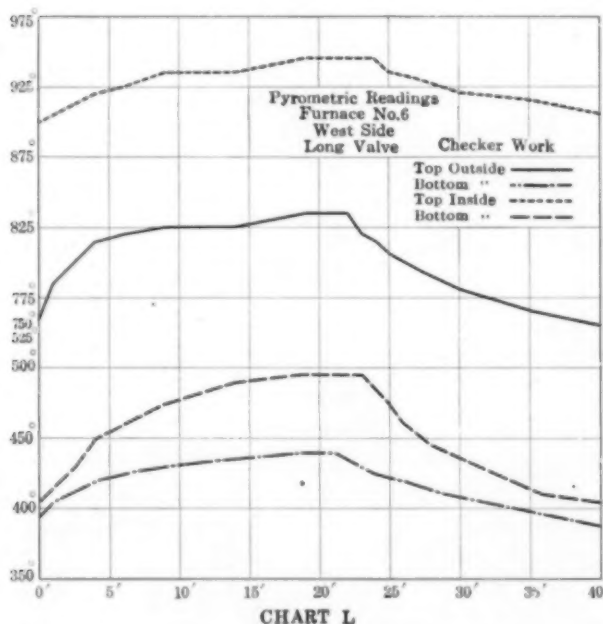
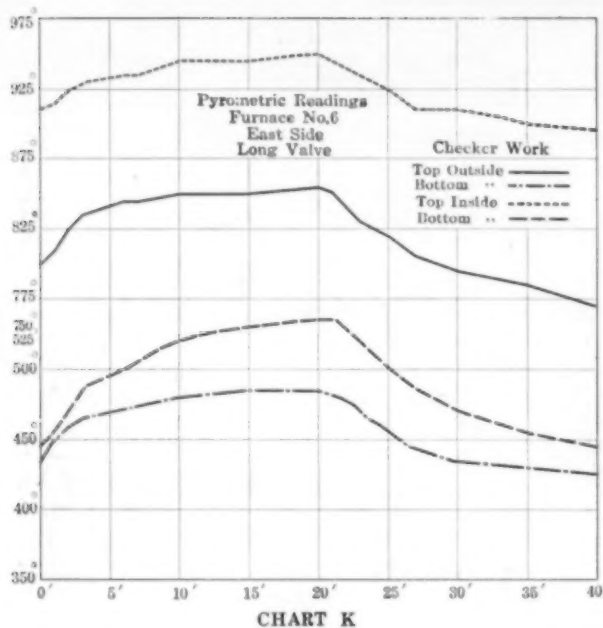


TABLE I—STACK TEMPERATURE
Furnace No. 6—Short valve; pyrometer enclosed.

EAST SIDE			WEST SIDE		
Time	Temp. ° C.		Time	Temp. ° C.	
1:42	415	Reversed $\frac{1}{2}$ hour damper.	2:01	375	
43	405		02	370	
44	395		04	375	
45	380		05	385	
46	375	Dumped coal in producer.	06	390	
47	375		07	395	
48	370		08	395	
49	365		09	400	
50	365		10	400	
51	365		12	405	
52	365		14	410	Dumped.
53	365		15	410	
54	365		17	415	
55	370		19	415	
56	370		20	415	Reversed.
57	370			397	
58	370		2:43	370	
59	370	Dumped.	44	375	
2:00	375	Reversed.	45	380	Dumped.
	375		46	385	
	375		47	390	
2:21	410		48	395	
22	400		50	395	
23 $\frac{1}{2}$	385		55	400	
24	375		3:00	405	Reversed.
25	372			388	
26	370		3:22	370	
27	365	Poked producer.	23	370	
28	365		24	375	
30	365		25	380	
32	365		26	385	
35	365		28	390	
38	365		30	395	
40	365	Reversed.	35	402	
	375		40	410	Reversed.
3:01	405			386	
02	395		General average, 390.		
03	380				
04	370				
05	365				
08	360	Dumped.			
13	358	Reversed.			
20	370				
	375				
General average, 375.					

closed in iron pipes were used, connected to a switch common to all, except in the case of the stack temperatures on long valve, when the naked pyrometer was used, and, as shown by the results, gave somewhat higher temperatures than the enclosed couple as obtained on the short valve.

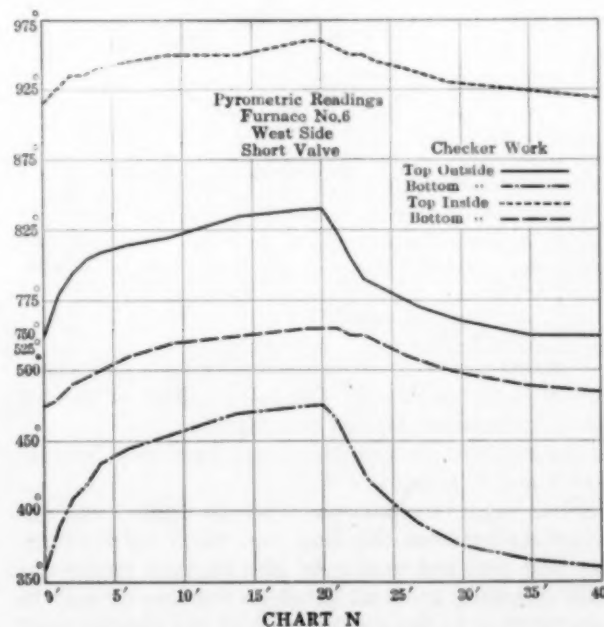


TABLE II—STACK TEMPERATURE
Furnace No. 6—Long valve; pyrometer naked.

EAST SIDE			WEST SIDE		
Time	Temp. ° C.		Time	Temp. ° C.	
2:24	420		2:30½	410	
25	410		41	420	
26	405		42	435	
27	410		43	445	Dumped.
28	415		44	450	
29	420	Dumped.	45	450	
30	415		46	455	
31	415		48	450	
33	415		50	450	
35	415		52	450	
38	420		53	455	
39	425	Reversed.	55	455	
	415		57	460	
			3:00	460	Reversed.
3:01½	420			445	
01	410	Poked producer.	3:20½	410	
01½	400		21	415	
02	395		22	420	
02½	390		23	430	
04	392		24	435	
05	395		26	440	
05½	400		28	450	
07	410		30	455	
08	415		31	462	Dumped.
10	415		34	475	
12	415		37	475	
15	425	Dumped.	39½	475	Reversed.
15½	430			445	
16	430				
17	425				
18	425				
19	425				
20	425	Reversed.			
	413				
3:40½	435				
40½	425				
41	420				
41½	410				
43	410				
44	415				
45	420				
46	425				
50	425				
53	425				
55	430				
57	435				
58	440				
4:00	440				
	425				
General average, 396.			General average, 417.		

TABLE III—STACK TEMPERATURES

Furnace No. 6—Short valve. Temperatures ° C. taken in channels between the outside end wall of furnace and damper boxes.

WEST SIDE				
	EE	EW	WE	WW
3:41	160	345	435	385
43	230	415	405	310
45	355	450	375	245
50	450	470	335	170
55	470	480	320	140
4:00	470	475	320	130
	322	439	365	230
General average, 339°.				
EAST SIDE				
	450	440	330	170
4:01	380	385	360	270
03	300	350	395	360
10	215	330	440	430
15	175	325	455	450
20	160	320	465	455
	280	358	407	356
General average, 350°.				

California yields commercially a greater number and variety of mineral products than any other State and probably more than any other equal area of the earth. Previous to 1916 the total annual value of her output was surpassed by but four other States, they being coal and iron producers east of the Mississippi.

Recent Development of the Côte and Pierron Electric Zinc-Smelting Process

INTERESTING and hitherto unpublished details regarding the most recent step in the evolution of the Côte and Pierron process have just been published by G. Flusin in the *Bulletin Technique de la Suisse Romande* of Nov. 17, 1917 (vol. 43, No. 23, p. 233).

A plant is actually in course of construction at Maurienne, near Epierre; it will be put into operation at the close of this year and its equipment will comprise four furnaces of 500 hp. each. The working capacity of each furnace will amount to four metric tons of zinc ore per 24 hours.

The essential features of the present modification of the C. and P. process are as follows:

1. Treatment of raw ores, without previous roasting (ordinary blendes, fluorspar-containing blendes, mixed ores containing blende and galena).

2. Use of lime and carbon as the only raw materials for the preparation of the fusion bath.

3. Use of a "compound" furnace formed by the co-operation of two adjacent furnaces, viz., one being an "arc-resistance" furnace and the other an "indirect-resistance" furnace, combined in such a manner as to constitute practically only one continuously operated unit. Smelting of the charges is effected roughly to some extent, in the first furnace with liberation of zinc in the form of vapor. The second furnace, which acts as a refiner, receives the crude metal in form of droplets and zinc dust and, without allowing it to cool down, and with an additional small supply of calories, separates it from all the entrained impurities by subjecting it to a second process of distillation, followed by condensation in the fluid condition.

As will be seen, the process consists of effecting fusion of zinc ore in an electric furnace in order to liberate the crude metal therefrom and of refining this metal at once, likewise in an electric furnace, as fast as it is produced while its temperature is still near that of volatilization.

It will be observed that the inventors have given up the method of smelting zinc sulphide ores with iron as desulphurizer and that they have reverted to the smelting of the raw ores in the presence of lime and carbon. On the other hand, they have been successful in avoiding the deleterious effect of CO and other gases and in doing away with intermediate formation of zinc dust.

The ores best suited for this process may have a range of composition as follows: Zn, 30-40 per cent; Pb, 5-15 per cent (incl. Ag.); Fe (as oxide or sulphide), 8-12 per cent; S, 20-30 per cent; CaO, SiO₂ or BaO, 10-15 per cent; Fl, 3-5 per cent; foreign metals, 2-3 per cent; As, 2-3 per cent (tolerated).

The Epierre type of furnace (500 hp.) is capable of smelting 4000-4500 kg. of ore per 24 hours, which corresponds to a current consumption of 2000-2200 kw.-hr. per metric ton of an ore analyzing 35 per cent zinc as the average. Only 1.5 per cent zinc remains in the slag. The metal as it comes from the condenser titrates at once 99.93 per cent zinc. The total losses amount to 8-9 per cent (sometimes only 6-7 per cent). The electrode consumption amounts to 12 kg. per metric ton of ore. The 500 hp. above referred to is distributed as follows: 350-375 absorbed by reactions in the fusion bath, and 150-125 in the condenser.

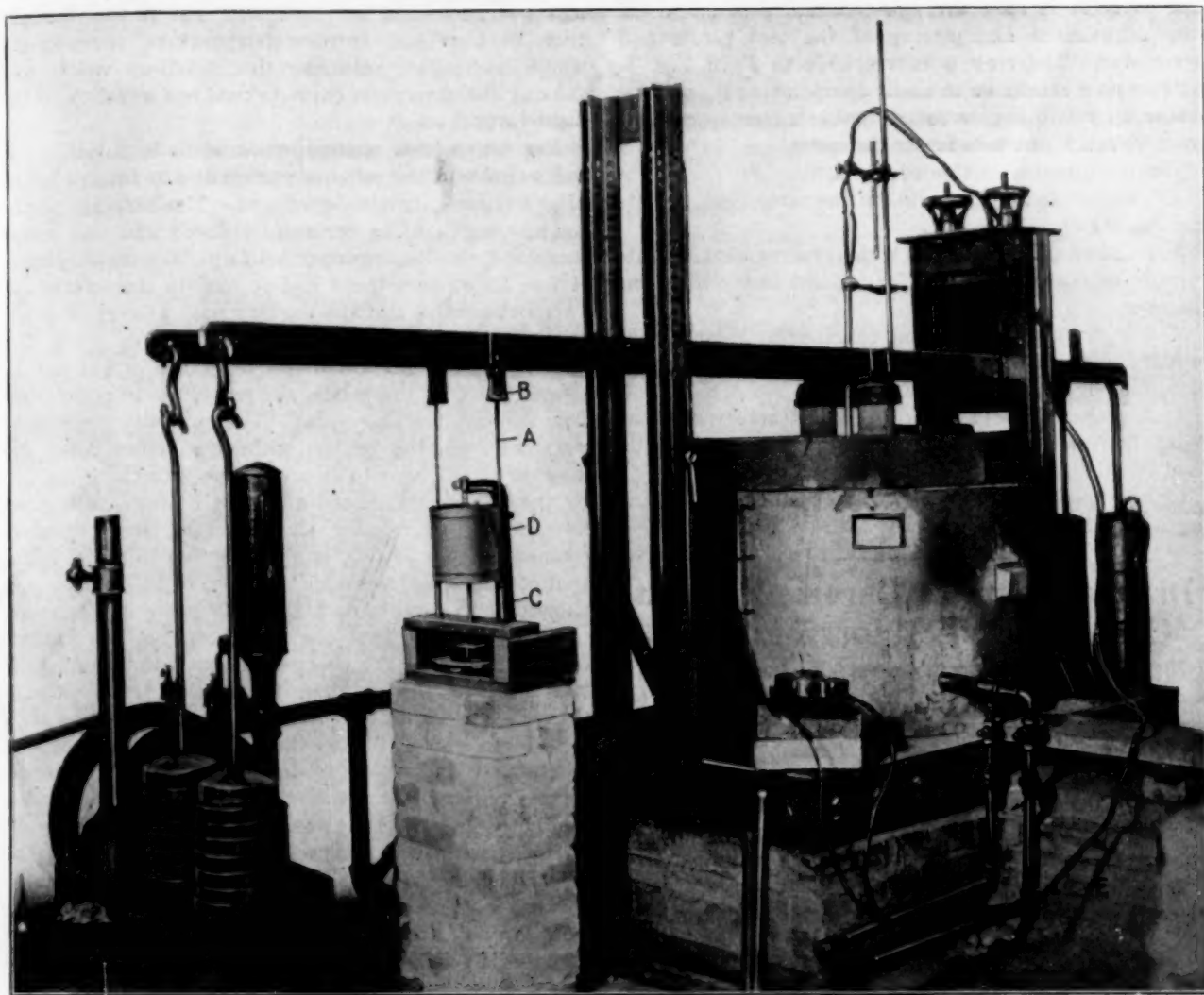


FIG. 2. FURNACE FOR TESTING REFRACTORY MATERIAL

end of the beam. A beam $\frac{3}{4}$ in. by $3\frac{1}{2}$ in. will take a load of 25 to 35 lb. per square inch on a standard sized fire brick without undue deflection and one $\frac{3}{4}$ in. by $3\frac{1}{2}$ in. will take a load of 75 to 100 lb. per square inch.

The beam is leveled at the beginning of the test, and it is not necessary to readjust after starting. The distance between the pivot and the knife edge is great enough not to cause any noticeable eccentric loading. With as high as 15 per cent shrinkage on the test brick the bar is not very far below the original level. By not adjusting the beam a drum recorder may be used to make a complete record of the test. A pyrometer with a three-foot element is inserted through the hole *R* in the cover and extends to the center of the combustion chamber. The cold junction of the couple is protected by an asbestos guard and a correction is made in the readings by adding one-half of the cold junction temperature to the galvanometer reading. The photograph Fig. 2 shows the furnace, with a blower for the air supply in the background. The vent or inspection holes may be seen in the sides of the furnace. The recording device is shown, which gives a movement of three times that of the test brick. The brass rod *A* is pivoted at *B* so as not to bind in the brass guides *C*. A pen *D* is mounted on the rod *A* and it engages the drum recorder. A horizontal flue *E* runs under the furnace to the stack.

Fig. 3 shows sketches of the special shapes required.

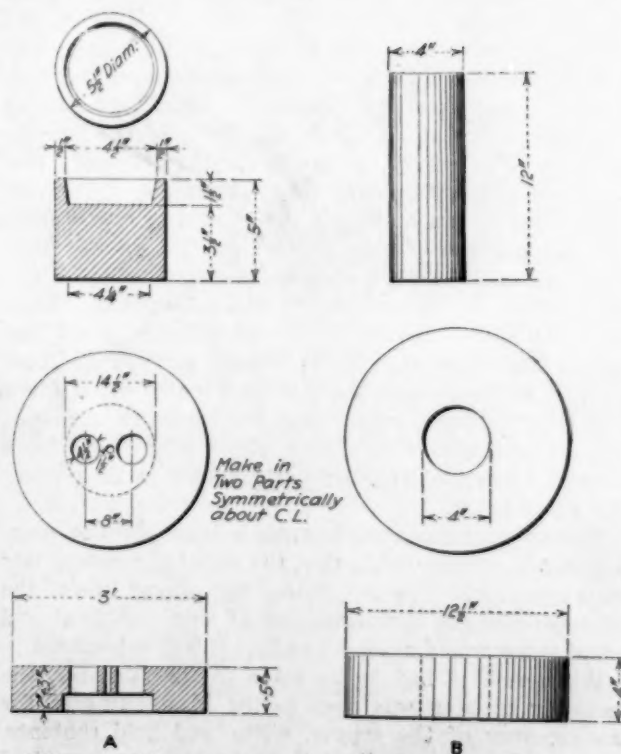


FIG. 3. SPECIAL SHAPES REQUIRED FOR FURNACE

The cover *A* is split through the center to allow the easy adjustment and placing of the test pieces and pyrometer. The ring *B* corresponds to *F* in Fig. 1. As this ring cracks quite easily in operation it could be replaced by two highly refractory brick or special refractory block as the base for the test piece.

The main points in this design are:

1. Two bricks may be tested at the same time, resulting in considerable economy.
2. A down-draft feature which increases the uniformity of the temperature throughout the combustion chamber.
3. The circular combustion chamber and tangential burners give better heat distribution than burners placed at right angles to the furnace.
4. A proper proportioning of the refractory cup and rods allowing maximum temperature and load to be used for the refractory tested.
5. A simple means of applying the load and of obtaining a continuous record of the test.

Disadvantages of Chrome Brick in Copper Reverberatory Furnaces

IN a paper to be presented at the meeting of the American Institute of Mining Engineers in New York, in February, 1918, Mr. FRANCIS R. PYNE offers the following notes on the disadvantages of chrome brick in reverberatory furnaces handling material too valuable to allow of much absorption by the brick.

Several years ago one of the large Eastern copper refineries decided to utilize basic material in place of siliceous material in the walls of their reverberatory furnaces for the treatment of very foul blister copper, as the latter rapidly corroded the siliceous linings.

Magnesite brick were first used, but while the corrosive action of the foul material was greatly reduced, and the amount of slag formed was very much less, the magnesite proved to be unsatisfactory in certain parts of the furnace, because of its tendency to crack and spall badly when subjected to the alternate heating and cooling that takes place in a reverberatory refining furnace. It was therefore decided to substitute chrome brick for magnesite brick in the parts of the furnace affected. The results, as far as the reverberatory furnace was concerned, were very satisfactory. The corrosion due to the action of the foul blister was small and the amount of slag formed was no greater than when using magnesite, and the tendency to crack and spall shown by the magnesite was eliminated. Gradually the use of chrome brick was extended to all furnaces, those treating blister copper as well as those melting cathodes, and the results were so satisfactory that the siliceous roofs were replaced by roofs of chrome brick except in certain places where experience showed a more satisfactory performance on the part of the silica brick.

It was immediately recognized, both for the magnesite and chrome brick, that the metal absorption was very heavy, but it was felt that the longer life of the furnaces and the decreased cost of slag treatment and metal losses would more than offset this disadvantage.

When repairs had to be made to the furnaces, the resulting cobbing was sent to the blast furnaces for the recovery of the copper, silver and gold contents. It was, of course, realized that chrome was a neutral

material and could not be fluxed, but it was thought that, at the blast furnace temperature, the cobbing would be melted, releasing the locked-up values and causing the chromium oxide to pass out mixed with the blast-furnace slag.

For a time this method appeared to be satisfactory, but as more of the cobbing was made and treated in the blast furnaces, trouble developed. The capacity of the settlers began to be seriously reduced and slag losses increased, due to improper settling. On investigation, it was found that there had formed in the settler, between the matte and the regular slag, a layer of thick, mushy slag which was causing the trouble.

This mushy slag could not be fluxed, could not be tapped out with the matte, and would not of itself overflow through the slag spout. The only way it could be removed from the settler, without shutting down and digging it out, was to insert a pipe into the layer and by the use of compressed air cause it to mix and overflow with the regular slag. While this procedure cleaned out the settler, it also resulted in metal losses that could not be tolerated. Samples of this mushy slag showed it to contain as high as 25 per cent chromium oxide, indicating that the cause was in the chrome cobbing added to the charge. Upon discontinuing the treatment of the cobbing, the settler trouble disappeared. The natural result of this was to accumulate a considerable stock of the chrome cobbing, and experiments were undertaken to devise a satisfactory process for the removal of the values that would leave a residue that could be sent to the dump.

The cobbing was crushed fine, thereby releasing the larger metallic particles, and treated in a reverberatory furnace with roasted pyritic ore and silica. This treatment gave a fairly fluid slag in which the chromium was apparently soluble. A considerable amount of the metal values was thus recovered, but the slag was still too rich in copper to throw away, and when sent to the blast furnaces induced a return of the former settler troubles.

Fine crushing and fusion with a very low-grade matte was expected to remove the values and leave a slag sufficiently low in copper to be discarded. The results were unsatisfactory, for though the matte absorbed much of the values, yet the slag was thick and pasty and contained considerable copper.

It was felt that crushing followed by mechanical concentration might result in separating the metal from the brick. Accordingly, the material was crushed and screened to remove the coarse metallics and was then treated on a Wilfley table. There was sizing, but little concentration.

Flotation was also tried without success, as the concentrate was too rich in chromium and there were too many values in the residue.

The most satisfactory solution yet found for the disposal of this material is to grind it, thereby freeing the larger metallic particles, and utilize the fine material in the manufacture of refractory brick, thus using the cobbing over and over again. There is, of course, some slagging action and a certain amount of chromium goes to the blast furnace where the mushy slag is formed, but in small amounts it is easily taken care of, and eventually the accumulated stock will be "worn out" and sent to the dump. There are also possibilities of treating this material by converting it into ferrochrome or by making chromate salts.

Our Resources

Address Delivered at the Tenth Annual Meeting of the
American Institute of Chemical Engineers, St. Louis

BY G. W. THOMPSON

President, American Institute of Chemical Engineers

WHEN we speak of resources we usually have in mind material things, such as financial, mineral and agricultural resources. It would appear, however, that this is a rather limited construction of the meaning of the word "resources," for with all of these material resources there is the presupposition that one has the ability to use them. Wealth owned by an idiot may not be to him a resource, but rather a liability. A mining deposit that no one knows how to work is hardly worth calling a resource. Wonderfully fertile fields in the centre of Africa are not resources, to the extent that they are removed from the intelligent use of civilized men. In our own country it is true that wealth, mineral deposits, and fertile fields are resources, but they are such because there are resourceful men in our country who can use them. If the present war teaches us anything, it is this: In these days wars cannot be won because a nation has great material resources only, but rather because a nation has resourceful men.

Let us consider this carefully and see whether what I have said is true and what, if it is true, it implies. Mexico is a country that is wonderfully rich in possibilities. Unfortunately for Mexico, whatever the cause may be, the Mexicans have not, themselves, so far developed their possible resources to their country's full advantage. In so far as these resources have been well developed, it has been because resourceful men have gone to Mexico and endeavored to turn mineral and agricultural resources to profitable ends.

The mechanical ability of the citizens of the United States has been recognized all over the world. Give him a mechanical problem, and it is not long before that problem is solved. His agricultural machinery, his machines for the manufacturing of food products, his machines for the stamping and molding of metal, his machines for the utilization of electrical energy, and hundreds of other kinds of machines are evidences of the great mechanical resourcefulness of our citizens.

It should be borne in mind, however, that the mechanical engineer's peculiar field lies in the taking of materials and turning them into machines. The materials must be furnished to him. On whom then does this furnishing of materials to the mechanical engineer mostly depend? I think it will be admitted that the furnishing of materials depends mostly upon the chemist. All of our smelting operations are highly developed chemical manufacturing processes. After metals have been won they must be combined together and with non-metallic elements, in order that they shall be serviceable to the mechanical engineer. Agriculture is a chemical process, and agricultural products must be treated or prepared chemically before they can be used to the best advantage. It may be that it is not as generally recognized as it should be that all smelting and agricultural operations are chemical operations; nevertheless we as chemists perceive this truth as a reality.

We see, therefore, that machines cannot be made unless the materials needed for them have been provided, and we see also that the production of raw and semi-raw materials depends, to a great extent, upon the resourcefulness of the chemist. Whatever the material resources of a country may be, these resources cannot be made fully effective unless efficient chemical processes for their utilization have been worked out.

I must say a few words here, lest I be misunderstood and be thought to be claiming too much for the chemist. In the development of a process for the production of the chemical elements or compounds, the chemist is essential. To make these products on a commercial scale, the mechanical engineer or his equivalent is also necessary. By the equivalent of the mechanical engineer we mean the person who knows how to apply material forces to machines and appliances so as to obtain effective results, and one also who knows how to construct these machines. The person who knows chemistry and chemical processes adequately and who also has a broad knowledge of the field of mechanical engineering, constitutes that modern product of which each of the members of our Institute is a representative—the chemical engineer.

Analysis and synthesis, to a certain extent, parallel each other. In analysis we seek to know the ultimate composition of substances; that is, the elements they contain. Having this information, we then seek to know how these elements are chemically combined; i. e., the constitution of the chemical compounds present. There are, therefore, two limits which confront the analyst. In making an ultimate analysis he cannot go beyond the elements themselves. He cannot decompose them into other constituents. The time may come when he will be able to do this, but the prospects are that that time is a long way off. The other limit lies in his determination of the constitution of chemical compounds. This is not a fixed limit, and the information we are obtaining every day is shoving this limit further back and widening the chemist's horizon. So, too, with the synthesist. He has the same fixed limit as the analyst. He cannot combine substances to produce elements, and he has a similarly continually widening limit as to the compounds that he can synthesize. He is adding continually to the superstructure which rests upon analysis.

METHODS OF DEVELOPING MATERIAL RESOURCES

The materials which a country needs may be obtained from its material resources in four ways, in all of which ways the chemist is preëminently the active factor.

First: By the production of commercially pure elements from minerals, such production being by methods which may with propriety be called analytical. In this way lead, silver, copper, etc., are obtained.

Second: By the production of such chemical compounds as are found in mineral deposits or in plant

and animal bodies. These compounds are isolated by methods that are also essentially analytical. In this way common salt, cane sugar, glycerine, etc., are obtained.

Third: By the production by synthetical methods of such chemical compounds as are referred to in Class Two. In this way indigo has been produced.

Fourth: By the production by synthetical methods of compounds not produced by nature, i. e., not found in mineral deposits or in plant and animal bodies. In this way innumerable inorganic compounds such as the salts of the heavy metals, and many inorganic compounds such as the so-called coal-tar dyes, have been obtained.

It is not to be assumed that these are the only ways in which the chemist is the active factor in the production of useful materials, but the four classes of materials given serve as a basis for the systematic study of our resources.

We will attempt now to review, in as general and condensed a way as possible, some of the resources of our country and the relation of the chemist to them, what he has done, what apparently he will be unable to do, and what we may hope for him in the future.

Considering the chemical elements which are included in Class One, it is quite evident that we have a reasonably ample supply of the minerals which contain the following elements: aluminium, arsenic, barium, boron, calcium, copper, carbon, iron, lead, magnesium, phosphorus, silver, sodium, titanium, and zinc. It is true that under pre-war conditions some of these elements, or the minerals containing them, were imported, but they were all produced in this country and the amount imported was insignificant as compared with home production. Elements such as arsenic, barium, calcium, magnesium, phosphorus, and sodium were mostly used in chemical compounds. Arsenic was produced mostly as a by-product of smelting operations, in the form of white arsenic. Barium was produced mostly as mineral barium sulphate or barite. Calcium and magnesium were produced to some extent as metals but were mostly in the form of chemical compounds. Phosphorus was produced to some extent as an element but was mostly used in fertilizers as acid phosphates. Sodium was produced in large quantities in the metallic form but was mostly used in chemical compounds such as caustic soda and sodium carbonate. The modern chemist gave us methods of producing aluminium, magnesium, phosphorus and sodium. The modern chemist has developed practically all of the metallurgical processes on which the production of copper, gold, iron, lead, silver, and zinc rests. He gave us the electrolytic refining of copper, the cyanide process for the recovery of gold, the structural knowledge of steel, the Bessemer and open-hearth processes for making steel, processes for the electrolytic refining of lead, and processes for the electrolytic production of zinc. All of these contributions of the chemist have greatly increased the output of these elements and rendered them more available for useful purposes. It is obvious, of course, that we have an ample supply of such elements as chlorine, hydrogen, nitrogen, oxygen, and silicon, all of which the chemist uses in the production of chemical compounds.

For some years before the war the production of bromine was a profitable industry, in spite of the unfair competitive conditions under which it labored.

In the case of carbon, we have an ample supply, although in its allotropic forms, graphite and diamond, we have not all of the supplies that could be desired. The chemist, however, has given us an artificial graphite which, to a great extent, has supplied our needs for this material, and he has also given us abrasive compounds that approach the diamond in hardness. With regard to all of these elements, the chemist is continually contributing to their more economical production and use.

We must not neglect to mention sulphur, which, when converted to sulphuric acid, is the basis, practically, of all chemical industries. Although large quantities of pyrite have heretofore been imported, the importation of sulphur itself has fallen to a negligible amount, due to the production of sulphur by the methods developed by Frasch. It would appear also that the recovery of sulphur compounds from smelter gases would, under normal conditions, more than supply our needs, taken together with our other sources of production. At the present time the supply of sulphuric acid may be considered as inadequate, but this is due only to extraordinary demands created by the war, and it would seem probable that even those demands could be met satisfactorily at an early date.

There are some elements of which we have no appreciable supply. One conspicuous example is iodine. Practically the entire world's production of iodine comes from Chile, where iodine is obtained as a by-product of the nitrate industry. If the need were great enough, however, iodine could be obtained by the old-fashioned method—from seaweed.

Antimony has been very little produced in this country, probably due to economic reasons, although scattered deposits have been found and worked. If the need were great enough, undoubtedly antimony could be produced. We are fortunate, however, in having a large quantity of antimony in the form of antimonial lead which is obtained as a by-product of the lead smelting industry, antimonial lead being suitable for most purposes where antimony and lead together are used. If the need came, there would be little trouble for the chemist to separate the antimony from the lead.

It is rather curious that there has not been a great quantity of manganese ore produced in this country. Just why this production has lagged is rather difficult to say with certainty. Manganese deposits exist, and even if they are not of the particular grade desired, say in the steel industry, their purification by chemical means is not difficult. The cheapness of manganese ores and recovered manganese obtained from abroad before the war was probably principally responsible for our undeveloped production here. It is true that a large quantity of manganese is obtained as a by-product from zinc ores in New Jersey, but that supplies only a small part of our needs. Should the importation of manganese ores and products be rendered more difficult, it would seem that the only way that the required amount of manganese could be obtained would be by the development of our own deposits and probably the calling in of the chemical engineer to develop methods of separation and purification.

We have no platinum deposits in our own country, but there are great quantities of platinum in the country in the form of jewelry, etc., that should be available for the war needs of our country.

We have no great deposits of nickel and cobalt and it would appear that we must depend, for some time at least, upon the Canadian supplies, it being very fortunate for us that we are on such friendly relations with our Canadian brothers.

Since the war began our lack of a supply of potassium salts has been manifest, not merely to us but to Germany, the country from which our supplies mostly came. It is evident that this shortage must be met, and it can only be met by the help of the resourceful chemist. It is not due to the absence of potassium from our mineral deposits that we have not been able to supply ourselves, but it is due to the fact that before the war started, the production of potassium in this country was not developed as a commercial proposition. There are large quantities of potassium in our feldspar, in our alkaline lakes, and in various materials used for the production of Portland cement and beet sugar. There are great quantities of potassium in seaweeds. The production of potassium compounds must be developed. Our country must be supplied, and it is up to the chemists to supply it. Considerable quantities have already been supplied and larger supplies may be expected.

We have no tin deposits of great value in this country, although tin is a widely distributed element, especially in the southeastern states. There seems to be no probability that the chemist will be able to do very much in the near future in the way of giving us a supply of tin ore. He has, however, been of invaluable assistance in the development of processes for the recovery of tin from tin scrap, and it would seem as if at some time in the future, when the stress is sufficiently great, methods will be developed for the collection of much larger quantities of used tin articles and their treatment by detinning processes whereby this semiprecious metal will be recovered.

There are many other elements, more or less rare, to which I could refer. What we have endeavored to show so far is that with regard to most of the elements the chemist has been an important factor in their production, and that the chemist promises, with some few exceptions, to be a still more important factor in the future.

IMPORTANCE OF SYNTHETIC PRODUCTS

We now come to Class Two, which are those chemical compounds found in mineral deposits or in plant or animal bodies. It would be convenient for us, however, to consider Class Three in connection with Class Two. In Class Three we have those chemical compounds referred to in Class Two, which have been produced by synthetic methods. With very few exceptions, the inorganic compounds included in Class Two, where the need has arisen, have been synthesized and appear in Class Three. It is true that certain minerals have not been synthesized in the physical form corresponding to the mineral; thus asbestos is mined as a mineral product and there has been no demand for the production of anything similar to asbestos by a synthetic method, as the supply which mostly comes from Canada has been reasonably ample.

So too with cryolite used in the electrolytic manufacture of aluminium. It is imported almost entirely.

It is when we come to organic compounds that the significance of our classification becomes more striking, and the chemist must admit that, while great progress

has been made in the knowledge of the constitution of organic compounds found in nature, the development of their commercial production synthetically has not made as great a progress as could be desired. It is true that some of the natural dye-stuffs, such as indigo, have been produced synthetically, but there still remains a very large field which is unworked. It seems probable that the lack of progress in this direction has been due to the abundance of our supplies. Our country has had ample quantities of sugar, starch, turpentine, oils, and fats, and hydrocarbons for its needs. It has been easier to produce these things by depending upon "mother nature" than it has been to work out synthetic processes. There need be no criticism of the chemist for this fact, but in the stress of war it is brought home to us how desirable it would have been if certain arts had been developed from our synthetic knowledge that would be available in our present struggle. There are certain things which we do not produce in appreciable quantities, such as shellac, rubber, and the fossil gums. Rubber has been produced synthetically, but, for some mysterious reason, when the methods were announced, the supply of rubber from natural sources became so great that the production of synthetic rubber was rendered unattractive commercially if for no other reason.

During the war the demand for glycerine has become very great. Some day a commercially profitable method for synthesizing glycerine will be developed. Perhaps we have learned our lesson so well that that day is nearer at hand than we dare hope. Let it not be supposed, however, that the chemist has not been active in these two important fields. While he has not developed, commercially, processes that actually synthesize many organic compounds of commercial value and produced by nature, the chemist has transformed many chemical substances into compounds of greater commercial value. The chemist has converted various oils into edible products. He has also, by hydrogenation, changed liquid oils to solid fats, bringing about a much closer parity in price between oils and fats of various origins. He has developed methods for more cheaply producing alcohol and acetic acid. He has produced sugars from starch. He has produced synthetic resins which, to some extent at least, have replaced shellac and the fossil gums. He has produced rubber substitutes which have at least the merit of having kept down to some extent the price of genuine rubber goods. He has developed methods for the recovery of rubber from waste products. He has converted mineral oil into satisfactory substitutes for turpentine. He has continually added to the yield of these natural and other products, by the study of the natural processes by which they are elaborated.

We must not neglect to mention the most important compounds found in nature, of which we have no natural supply. I refer to the nitrates. We have no nitrate deposits, but in that respect we are not less favored than most other nations. The nitrate supplies of the world, for a great many years, have come from one part of the west coast of South America. Germany was one of the first countries to realize its deficiency in this respect, and Germany bent its best efforts toward producing nitrates synthetically. At first her supply of synthetic nitrates was developed in Norway where great water-power resources existed. Later, to make herself

more self contained, she developed other processes, so that to-day she is practically independent of South America and Norway. Without discussing the merits of any particular process for producing nitrates, it is apparent to us that it will not be long before our country has adequate supplies. Partly, it may be by processes originally developed in this country, involving the direct combination of nitrogen with oxygen, and partly, by other processes involving first the production of ammonia and then its oxidation. It seems probable that next to sulphuric acid, nitric acid is the most important chemical needed in the development of our industries, and we should look forward to the much delayed time when nitrogen compounds will become more available.

It is in Class Four, however, that the chemist has been so conspicuously effective, for in Class Four we have those compounds which are not found in minerals or in plant or animal bodies, but are essentially artificial compounds. Here we could fill a long list, if we were permitted, of the inorganic compounds alone that the chemist has produced from every one of the elements by combining it with others. If we attempted to list the organic compounds produced, the list would probably be longer than that of the inorganic compounds. So far these purely synthetic compounds have not shown themselves to possess food values, but as decorative materials, as preservatives, and as medicinals their use has been very great. In the dye industry the artificial dyes have largely displaced natural dyes.

Considering the foregoing as a description of the four classes of materials which constitute the material resources of our country, a very proper criticism could be made that this account is very crude and inadequate. It serves, however, the purpose I have had in mind and which I have already outlined as illustrating the relation of the chemist to our resources, and it serves also as a preface to certain other very important considerations which I will now attempt to outline.

NECESSITY FOR PROTECTING NEW ARTS AND INDUSTRIES

During the present war many processes have been developed in this country for the purpose of increasing our supply of needful materials. Many of these processes have been developed into successful commercial form. Arts have been established.

I think every one who has been instrumental in developing these arts, and many others also, have asked themselves what is to become of these arts when the war is over. Are these arts, due to foreign competition, to become extinct and lost as it were, or will they be able to stand on their own feet in face of that competition? The answers to these questions will vary according to the arts. Some have, undoubtedly, become firmly established and will withstand foreign competition. Others, undoubtedly, will tend to become lost arts, and this tendency should be considered as most unfortunate. Now is the time to study this question and prepare to meet it when the war is over; meet it if need be by allowing the arts to perish, or, if it is more desirable to maintain the arts, by appropriate methods of procedure.

Let us consider this by way of illustration. As indicated above, the production of potash in this country is not to-day equal to the demands of our country. It

would seem probable that when the war is over, if Germany follows its old practice of unfair competition, the potash industry will have to cease operations. Potash can be produced in Germany and sold here probably cheaper than we can make it in the near future. A great deal of money has been expended in the development of the art of producing potash in this country. Shall we allow that art to become extinct?

Our government has prepared for the expenditure of a large sum of money for the fixation of nitrogen and the production of nitrates. It can hardly be expected that when the war is over and the demand for nitrates falls off, that immediately the processes and arts which have been developed will be able to withstand the competition of Chile. Nitrates can be produced in Chile at a figure which will probably be lower than what they will be produced for in our government plants when the war is over, unless the war lasts for a long time.

Artificial rubber has never been manufactured in this country. Chemical processes involving its production synthetically may be known. The war has created a great demand for rubber. Should the war last long enough, it might be profitable to develop the production of synthetic rubber, and after the war the art would find difficulty in living.

This prospect of any art perishing in our country is not a pleasing one to me, because it involves a loss of resourcefulness which to me is of more importance than a loss of resources.

The examples I have referred to are by no means the best examples that could be selected. Each of you can probably suggest a better example. They serve our purposes, however, and indicate our needs. They present to us a problem which deserves very careful consideration. Many solutions of the problem can be offered. Undoubtedly, in the case of nitrates, the production can be continued even at a loss after the war is over, provided sufficient pressure is brought to bear upon our legislators.

In the case of potash the problem is somewhat different. Such production is to-day in private hands, and it would appear unreasonable to expect private capital to continue for any length of time to operate a losing or unprofitable business. Undoubtedly, after the war is over more potash will be produced at a profit in this country than there was produced before the war, but the amount will be insignificant. I hold no brief for any potash manufacturer and do not know, directly or indirectly, anyone engaged in such manufacture. Therefore what I have to say is entirely disinterested. We have to-day government-controlled industries. This government control of industries is a war measure. I would hesitate to advocate any control of industries, in general, in times of peace, but wherever there is a case like the potash industry, which is very important to the life and progress of our nation, it seems to me that we have a special case involving special forms of treatment and consideration. It is not very desirable now that any branch of the potash industry be made a government-controlled industry, but when peace comes it seems desirable that some, at least, of the potash industries be put under government control, so that the arts so far developed will be maintained and further development provided for. I believe that the potash industry should be controlled and subsidized, the ex-

pense of the subsidy perhaps being met by a very small tax upon imported potash.

In the case of artificial rubber, it would seem that the rubber manufacturers could afford to organize an institute which would be profitable to all the manufacturers and be for the purpose of developing methods for the production of artificial rubber and allied products. It seems that here government assistance should not be necessary as in the case of potash. The rubber manufacturers should, if practicable, establish an art which could be controlled by patents, each of the rubber manufacturers deriving proportional benefit.

What we have suggested with reference to the nitrate, potash, and rubber industries, should be considered only as types. Perhaps there are other products in regard to which a method of treatment could be developed similar to that suggested in these three cases.

What I have endeavored to indicate in this paper is this: It is not sufficient for us to consider simply what our resources may be, but we should also consider how our resourcefulness can be developed. Undoubtedly much can be done by the education and employment of more chemists and the better education of each chemist. Much can be done by the broader and more intelligent education of chemical engineers, but there still remains the problem of maintaining such arts as have been developed during the war, and the further development of the new and old arts which are now successfully practiced. In some cases I firmly believe that the maintenance of these new arts and the development of other newer arts cannot be accomplished unless there is a broader conception of the advantages of community action based upon community interests.

Brooklyn, N. Y.

The Use of Culm and Other Waste Materials from Coal-Washing Plants for Other Purposes

BY JOHN B. C. KERSHAW

ONE unlooked-for result of the increased cost of labor and transport in all manufacturing countries is that the "dumps" of waste-fuel in colliery districts are growing in size, and that the proportion of fuel left in the mines as "unmarketable" and not worth bringing to the surface, is far greater than is desirable from the point of view of national economy.

Large consumers of fuel, in towns and cities far distant from the coal-mining areas, have in fact now recognized the absurdity of paying high freight and railway charges upon such incombustible matter as water and ash. Consequently washed and properly graded coals are rapidly growing in favor with these classes of consumer. The coal-washing and cleaning plants at the pits tend, therefore, to multiply in all up-to-date mining centers, and the dumps of culm and other washery refuse are growing in size and in economic value.

So far the attempts to utilize this waste material for steam-raising, or other power purposes, have been confined chiefly to the mining companies themselves, but with the extension of their plants the time is rapidly approaching when they will be unable to burn or gasify even a small proportion of their total output of this low-grade fuel, and its sale to outside consumers will become necessary.

Owing to the high percentage of incombustible matter, it will not pay to transport the material far from the mining centers where it is produced, but within a certain limited radius of five or ten miles, culm and washery refuse, when burnt under steam boilers or gasified in producers, form very valuable cheap fuels for power generation.

Special types of furnace grate and of gas producer are, however, necessary in order to obtain good results with these materials, and pertinent facts and figures are here given, based upon recent practical trials in England, America and Germany.

THE UNITED KINGDOM

The early attempts to utilize low-grade fuels for steam-raising in the United Kingdom were made in furnaces of the "destructor" type, for it was recognized that it would be impossible to obtain a decent evaporative efficiency from fuel, often containing from 25 to 35 per cent of ash, in the ordinary type of boiler furnace.

Goodrich, in the *Engineering Magazine* some years ago, pointed out that a Lancashire boiler with a grate area of only 38 sq. ft., could not possibly maintain its proper rate of efficiency with a fuel, the evaporative efficiency of which was at the best only 4 lb. of water per pound of fuel, and he proposed that the grate area should be doubled, and that compressed air should be employed to support the combustion. External brick cells with grate areas of from 50 to 75 sq. ft. were therefore provided, and under these conditions, with forced draft, an evaporation of 10,000 lb. of water per hour, with a Lancashire boiler measuring 30 by 8 ft., became possible. This Dutch-oven type of furnace, however, while quite useful for large sized material like "culm" and the "brasses" from hand-picked coal, was found to be impracticable when fine-grained material and the refuse from coke-washeries had to be burned, and the Bettington type of tubular boiler has now come to the front, as the most suitable for steam-raising purposes, with these classes of finely divided low-grade fuel. This boiler has often been described in the technical press, and some of the latest tests with it are recorded in the *Journal of the Society of Chemical Industry* (1917), p. 114.

Professor Cobb, however, in a paper read in April last before the Midland Section of the British Coke-Oven Manufacturers' Association, has pointed out that the Bettington boiler will require modification in some re-

spects before it can completely burn large-sized grains of coal and coke. The time during which the particles remain in the combustion zone of the boiler with the present design is far too short to allow of their complete combustion. The question of the best materials for the refractory lining of the boiler is also not yet settled, for the high temperature and the molten ash or slag combined have a most destructive action upon it. However, these difficulties will no doubt be overcome in time, and when they are the Bettington boiler will no doubt prove the most efficient type of steam producer, when fired with the finely divided waste materials from coal-cleaning plants and coke-washeries.

The coal-dust that accumulates upon the floors and edges of mines, and proves such an added danger when explosions occur, could also be collected and utilized for steam production if a battery of Bettington boilers were installed at or near the pit-head in all coal-mining districts.

COLLIERY DUMPS USED FOR GAS PRODUCTION

As regards the use of waste fuels for producer work in the United Kingdom, Fernald in Technical Paper No. 128 of the Bureau of Mines (published in 1915), gives some figures obtained from the manager of a large English colliery and iron works which had been equipped with a mechanically operated eccentric-grate gas-producer. Several types of producer have been designed for working with fuels high in ash content, and the more successful are provided with some form of revolving eccentric grate for removing the ash automatically, and for preventing blocks due to the formation of large masses of clinker in the lower part of the shaft. In the best form of these producers the degree of eccentricity and the speed of the grate can be varied to suit the amount and the fusibility of the ash formed by the fuel used.

In the particular case referred to above, a water-jacketed revolving-grate producer was installed for the purpose of utilizing the "batts" from the mine dumps of waste fuel, "batts" being the local term for the larger pieces of shale containing a good proportion of coal. It has been found in practice, however, that better results can be obtained by crushing the larger material, and by passing both the large and small through a washing-plant before charging into the producer. In this way the dump at this mine is being gradually reduced in size, 115 tons of the unwashed material yielding 60 tons of nuts (classified as Nos. 1, 2 and 3) and 40 tons of slack. The sample of the original waste-fuel taken from the dump tested as follows: Moisture 6.99 per cent, ash 52.12 per cent, volatile matter 18.37 per cent, fixed carbon 22.52 per cent, and the calorific value of the undried fuel was 5065 B.t.u. After washing, the fuel tested: Moisture 5.85 per cent, ash 24.60 per cent, volatile matter 28.75 per cent, fixed carbon 40.79 per cent, and the calorific value of the undried fuel had increased to 9869 B.t.u. The manager stated that the producers operated well with this washed material, and that their success in dealing with it was due to the water-jacket. The slag contained on an average only 4 per cent of combustible.

COKE BREEZE OR "BALLAST" FOR GAS PRODUCTION

In the publication referred to above, Fernald also gives some details of the utilization in England of coke

"ballast," which is the name given to the "fines" produced when screening coke. The gases from the producers in this case were employed for firing brick kilns and were non-by-product producers, with stationary grates. The "ballast" used showed the following composition as regards size: 40 per cent passed through a $\frac{1}{2}$ -in. sieve, 19 per cent was between $\frac{1}{2}$ in. and $\frac{1}{4}$ in., 14 per cent between $\frac{1}{4}$ in. and $\frac{1}{8}$ in., and 27 per cent was less than $\frac{1}{8}$ in. The analysis of this material gave the following figures: Moisture 10.77 per cent, ash 12.05 per cent, volatile matter 4.92 per cent, fixed carbon 72.26 per cent, calorific value, in B.t.u., 11,160.

The fuel was therefore not a low-grade fuel in the sense that the ash content was high, but simply on account of its fine state of subdivision. In recent years a considerable demand for this class of fuel has been created by electric power engineers, who use it for mixing with the cheaper varieties of bituminous fuel before burning this under steam boilers. This method of utilizing coke breeze was referred to in the second article of this series, printed in the issue of METALLURGICAL AND CHEMICAL ENGINEERING for Sept. 1, 1917.

AMERICA

One of the most notable installations in America for utilizing the refuse coal from the washing plant attached to a large mine, is that erected by the Lehigh Coal and Navigation Company at Hauto, Pa., and described in *Electrical World* for May, 1914. This coal mining company mines in the anthracite coal area and places on the market the ordinary commercial sizes of anthracite. Although the calorific value of the refuse from the washing plant is from 9000 to 11,000 B.t.u., there is no profitable sale for it on account of the large proportion of dust it contains.

The original capacity of the power plant was 30,000 kw., but it is to be increased to 100,000 kw., and some idea of the amount of refuse to be dealt with can be obtained from the fact that in the production of the size known as "stove-coal" alone the Lehigh Company turns out enough refuse to run the whole of the enlarged plant. The original plant comprised eight Babcock and Wilcox double-ended units. Each boiler is provided with four grates, half of each set being fired from one side and half from the other. The boilers are of the five-drum bent-tube type, equipped with superheaters, and are designed to carry 225 lb. of steam pressure. Exclusive of the superheaters, each boiler has 10,000 sq. ft. of heating surface. Six of the boilers are equipped with hand-fired dumping grates of special design, and the two remaining units are equipped with automatic traveling grates, a development of the Coxe design. In the case of the hand-fired furnaces the grates are 12 ft. deep and 8 ft. wide, making the total grate area 384 sq. ft. per boiler. Four of the boilers are provided with Acme slotted-top grates and two are equipped with pin-hole tops. In each case about 6 per cent of the total grate area is occupied by air-apertures, the holes or slots being about $\frac{3}{32}$ in. wide. The apertures are at the bottom of grooves moulded across the grate-tops, at right angles to each other, giving the appearance of a waffle-iron. The grooves are provided in order to prevent the fine coal from choking the apertures and thereby hindering free circulation of air through the furnace. Other features of the furnace are the use of vertically sliding furnace doors, recessed ash-pit doors, and shaker-

handles to prevent obstruction to the firing aisles, double fire-arches, cinder catchers, ventilation of fire-wall to prevent burn-outs, and independent brick-settings which are not affected by expansion of the metal parts. Double superposed fire-arches are provided so that if the lower one burns out, the upper one will come into use. Between the superposed arches is an air-space through which air is allowed to circulate slowly, in order to prevent the firebrick temperature from reaching such a value that the material deteriorates. The space over the grates is practically a reverberatory furnace, which ensures the complete combustion of the fuel. The fire-arch is 9.5 ft. long and covers two-thirds of the grate-area. The combustion-chamber above the brick wall is unusually large, and is so designed as to reduce the velocity of the gases and allow any unburned fuel to drop back into the fire and be consumed. The gases from four furnaces under each boiler pass up through the central combustion-chamber and then divide at the top, going through two passes, striking the flues and superheaters (of which there are two to each boiler) and then following the vertical uptakes at the boiler heads to the roof of the station, where they join a common stack. Whatever unburned fuel or cinder may be carried over into the first pass of the boilers is thrown out by centrifugal force at the bottom of the pass into a cinder-catcher. The steam is employed to drive three turbo-generators, each of 12,500 kw., generating current at 11,000 volts. When running at their full load and maximum efficiency, these units consume 12.3 lb. steam per kw.-hr. with a vacuum of 28 in. The electric energy is transmitted at 110,000 volts to various coal mines and cement mills located in the vicinity of the Hauto supply station. The transmission line, however, has been designed for long-distance work, and possibly in time the cities of New York and Philadelphia may receive current from this waste-fuel electricity supply station.

Another example of an American coal-mine electric power-station which is using waste-fuel for steam-generation is that provided by the plant of the Cadogan Mine in Armstrong County, Pa., a detailed description of which was published in *Coal Age* on Dec. 2, 1916.

The fuel in this case consists of 50 to 75 per cent refuse from the tippie picking-tables, mixed with slack. The boilers are Heinz watertube boilers, rated at 470 hp. at 150 lb. working pressure, and provided with a grate-area of 84 sq. ft. Each boiler is fed by three mechanically-operated underfeed stokers, forced draft being supplied by one blower-fan driven by two direct-coupled steam engines. The ash is removed by steel cars running on rails directly below the discharging holes of the retorts. The generating plant consists of two 375-kw. alternators coupled direct to Corliss valve steam engines running at 150 r.p.m. These engines consume 21.6 lb. per hp.-hr. at full load, 21.3 lb. at three-quarter load, and 21.8 lb. at half load. The energy developed is used chiefly for cutting, haulage and pumping purposes at the mine, but as transmission is an important point, it is generated at 2,300 volts, and is converted by motor-generator sets to direct current at 250 volts at the various points where it is required.

The general conclusions that may be drawn from American experience and practice with these low-grade fuels are two: First, it is recognized that some form of artificial draft is requisite for the proper combustion

of the smaller sizes of fuel waste, forced fan-draft operated on the "balanced-draft" principle being most favored. Secondly, it has been proved that only in exceptional cases will it pay to grind or pulverize the lump waste fuel in order to burn it in dust form. When the fuel is brought to the surface in this finely divided state this method of burning is, of course, the most efficient, but in nearly all cases the fuel is too poor to pay for the cost of artificial pulverization. The heat produced by burning rich "culm" in the dust form is sufficient to melt all forms of refractory material, but this is an exceptional material, and the greater number of waste fuels contain so large a proportion of ash that when burnt in the dust form the temperature produced is not so high as that attained under ordinary conditions with lump fuel.

GERMANY

Experimental trials were carried out by Butow & Dobbstein in 1910-1911 for the Westphalian Mine Owners' Association in connection with the utilization of waste fuels at the mines, and a summary of the results obtained and conclusions reached has been published from time to time in the German mining paper *Glückauf*. Butow and Dobbstein state that low-grade fuels may be classified according to their origin as follows: (1) Coarse-grained material with ash content up to 50 per cent and water up to 20 per cent; (2) fine-grained material with ash content up to 40 per cent and water up to 30 per cent, and (3) small-coke and coke-breeze with ash content up to 30 per cent and water up to 20 per cent. Two methods of utilization for these low-grade fuels are open to the engineer: they may be burned under steam boilers either alone or in conjunction with other materials, or they may be gasified in producers. Fuels of class (1), they assert, can be burned directly without admixture with other material, but the steam-raising efficiency of the boiler is very low, and such fuels can only be employed in large boiler installations. The application of forced draft gives very little advantage in the case of these fuels, and their utilization directly for steam-raising purposes is therefore restricted to special cases. Fuels of classes (2) and (3), when they can be obtained, yield the best results when fired together, this being specially the case with the fine coal from a rich or gas-coal and coke-breeze, which together yield an excellent firing material for steam boilers. In this case the use of forced draft increases the efficiency of the firing. As regards fuels of class (3), Butow and Dobbstein state that these can be fired alone if they contain 10 per cent of volatile matter and if forced draft is available. Coke-breeze containing less than 10 per cent of volatile matter cannot be fired alone, however, and if no fine material from a rich or gas-coal is available for mixture it must be briquetted with the aid of pitch. Should the ash and water contents of the breeze exceed 30 per cent it will not pay, however, to briquette it, and for this material, as for the lowest grades of classes (1) and (2), gasification in producers is the only practicable method of utilization.

In a later report the same two engineers give details of steam-raising tests made in July, 1911, at the mine "Prosper," with low-grade fuels and a traveling-grate stoker. Fuels containing from 9 up to 22 per cent ash and from 2 up to 13 per cent water were used in these tests. The fine coal from the coal-washing plant and the

coke-ashes could in neither case be burned alone, and were in the final tests either burned together or mixed with the other fuels. A Dürr boiler possessing a heating surface of 1640 sq. ft. was employed in the tests. Six tests were made with the following products: (1) Rejected fuel from the washing-plant. (2) No. 1 fuel mixed with coke-ashes in the proportion of 2 to 1. (3) Dust from nut coal mixed with coke-ashes in the proportion of 3 to 1. (4) A mixture of two parts of fine coal-dust with one part of coke-ashes. (5) A mixture of equal parts of fine coal-dust and rejected fuel from the washer. (6) Dust from nut-coal alone. The following results were obtained: Pounds of steam obtained per pound of fuel burned—(1) 5.61, (2) 4.96, (3) 4.16, (5) 4.45, (6) 5.55. Boiler efficiencies—(1) 58.96, (2) 53.18, (3) 42.93, (5) 48.74, (6) 55.95. The cost of 1 ton of steam using rejected fuel from the washing-plant, was only 18 cents, of which total fuel represented 12 cents.

As regards the use of these waste fuels for gasification, Butow and Dobblesstein state that the chief difficulty encountered has been the bulk of the slag and ashes which have to be removed, and the tendency of this to fuse together into large masses and to disturb the normal working of the producer. The producers experimented with were (1) the Mond producer and (2) the Erhardt and Schmer producer. Coke-ashes containing 19.4 per cent ash and 20.7 per cent moisture were used. The trial of the Mond producer with this fuel failed, owing to the air-pressure required to burn it being sufficiently great to blow out the water-seal. So far as could be judged from the preliminary results of the test, 35 cu. ft. of gas testing, 112 B.t.u. per cubic foot, would cost 4.7 cents, without any allowance for labor, depreciation or interest charges.

The trials with the Erhardt and Schmer generator were more successful, as this producer possesses a rotary hearth which retained all the fuel in the lower part of the charge in continual motion and thus prevented clinker formation. In this case a mixture of equal proportions of coke-ashes and refuse from the washing and sorting machines at the mine was used, and after the method of burning the generated gas under a Lancashire boiler had been modified very successful results were attained. The following is an estimate of the cost of evaporating 2204 lb. of water with this cheap fuel-refuse:

Labor	9.6 cents
Interest and depreciation.....	9.6 "
Fuel	6.0 "
Feed water.....	1.2 "
Power for motor.....	1.6 "

Total.....28.0 cents

For a larger plant this low cost could be still further reduced, as the same labor would suffice for two producers, and 2204 lb. of water could then be evaporated for 24 cents. By use of the gas in a gas-engine, still more favorable results could be attained.

Finally, a report made by Mann and Müstefeld upon the gasification of low-grade fuels, and published in *Glückauf* in 1912, may be referred to. These authors state that the chief characteristic which determines whether a fuel is to be classed as "low-grade" is the fineness of its particles; ash and moisture are of secondary importance. The factors that determine whether

any particular low-grade fuel will pay for its gasification are (1) the chemical composition of the gas that can be produced from it, and (2) the cost of obtaining one calorie, or heat-unit, in the gas produced. The chief difficulty in working gas-producers with these low-grade fuels is due to the finely divided state of the particles. This causes great resistance to the air supply inside the producer. Incomplete combustion occurs in consequence and the yield of gas is diminished. Air-channels are also formed in the burning mass of fuel which lead to further disturbances of the normal conditions of work, since these air-channels carry an excessive air-current and result in the formation of CO₂ in place of CO.

The authors give details of trials made with the Mond, Erhardt and Schmer, Maschinen Fabrik Augsburg, and with the Kerpely producers, when using this class of fuel. The steam required to operate the different types of generator varies from 15 to 18 lb. per 100 lb. of fuel in the case of the Kerpely producer, up to 200 lb. in the case of the Mond producer. The Kerpely high-pressure producer is finally described in the form specially designed for gasifying finely divided low-grade fuels. A satisfactory gas composition is obtained from these producers by the use of a great depth of fuel-bed and by a uniform distribution of the air-supply over the whole area of the combustion zone. The ashes and clinkers are continuously removed as the gasification of the fuel proceeds. The following tests show the chemical composition of the gas made in a Kerpely producer during six separate trial-runs.

	1	2	3	4	5	6
CO ₂	3.00	5.18	10.0	7.0	2.4	4.1
CO.....	30.20	26.66	21.9	27.4	32.5	29.5
H ₂	14.85	15.01	22.2	18.3	12.3	14.5
CH ₄40	1.30	2.0	2.5	1.4

In conclusion, it may be pointed out that the subject of the utilization of these low-grade fuels has a far wider bearing upon the future of American manufacturing industries than is generally recognized. At present from 20 to 35 per cent of the fuel reserves are being left in the mines, because there is no market for the poorer classes of fuel.

Those who imagine that the poorer seams of coal can be worked and brought to the surface when all the richer seams have been exhausted only show their ignorance of mining operations by this belief. It is therefore incumbent upon all who have the future welfare of their country at heart to study the methods of utilizing low-grade fuels, and to do what is possible to create a market for them while the seams are still exposed and their extraction from the mines is a practicable proposition.

Colwyn Bay, North Wales.

New York State Branch of American Ceramic Society.—A meeting was held in Hornell, N. Y., on Nov. 19 and 20 for the organization of a New York State Branch of the American Ceramic Society. The following officers were elected for 1918: President, L. E. Barringer, Schenectady; vice-president, Frederick Carder, Corning; secretary, J. B. Shaw, Alfred. It was decided that a meeting should be held quarterly, the next meeting to be called in May at either Syracuse or Schenectady.

A Volume Regulator for Blast-Furnace Engines*

BY L. C. LOEWENSTEIN

BLAST-FURNACE operation has attained a high degree of refinement in the proportioning of the various materials composing the charge—the ore, the fuel and the flux. The weight of oxygen—introduced as atmospheric air—per charge has, however, until recently been subject to much uncertainty due primarily to the difficulty of measuring with any degree of accuracy the volume of air delivered. The adjustment of the air supply to the furnace was, therefore, usually made only when the operator found evidence that the furnace was badly overblown or underblown, a process which resulted in a more-or-less variable product and certainly in a reduction in the possible maximum output of the furnace.

With the advent of the centrifugal compressor giving a perfectly steady air blast, the metering of the air supply became more practical and, therefore, more usual. With perfectly definite and uniform charging a definite and uniform weight of air per minute is desirable. Constant-volume governors have been designed on two principles, one by metering the air by means of a venturi meter and the other by using an impact float. The venturi-meter governing has been improved by using a multiple venturi meter in which large pressure drop can be obtained in the throat without a corresponding loss in power. This difference in pressure is used on a mercury pot whose motion up and down is translated to the governing mechanism of the driver of the air compressor. The proper setting of this meter is accomplished by changing the tension of the spring until a scale calibrated in cubic feet of air per minute shows that the desired quantity of air is obtained.

In the impact float method the air is taken through a conical opening in which is suspended a float, this float moving a horizontal beam about a pivot. The horizontal beam actuates the governing mechanism of the driver of the air compressor. On this horizontal beam is a sliding weight which can be set at calibrated marks representing cubic feet of free air per minute. With the weight set in a definite position a certain definite quantity of air is obtained.

In both of these methods, however, the readings on the calibrated scale are only correct when the initial air conditions are standard, that is, are similar in barometer, temperature and humidity to which the scale has been calibrated. Any change in either the temperature of the inlet air or in the atmospheric barometer or in the humidity of the air, changes the weight of the air metered, and, therefore, its oxygen content. As the blast furnace requires an exact weight of oxygen, the above method of holding constant volume is liable, in extreme cases, to have an error of from 15 to 20 per cent.

THE VOLUME CORRECTOR

A volume corrector is herewith presented which when used in connection with the air-metering device will correct for any changes in either temperature, barometer and humidity, so that the air supplied to a blast

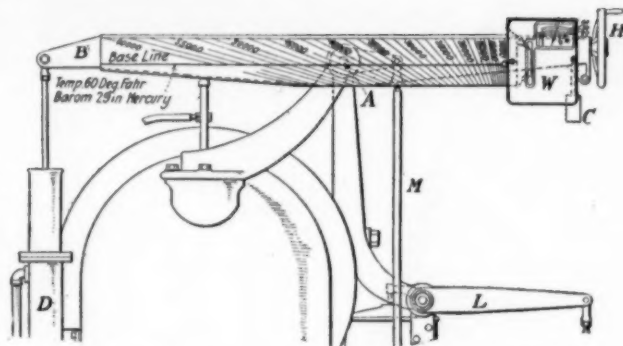


FIG. 1. VOLUME CORRECTOR APPLIED TO IMPACT FLOAT GOVERNOR

furnace will, at all times, under any atmospheric conditions, deliver a perfectly definite and predetermined weight of oxygen to the blast furnace. This volume corrector is so designed that it requires only one setting for each correction, that is, one setting for any initial temperature, one setting for any existing barometer and one setting for humidity as usually obtained by the difference of readings on a wet-and dry-bulb thermometer.

It can be applied to the sliding weight and calibrated scale of an impact-float constant-volume governor for correcting this governor when handling air of any temperature, barometer or humidity. An instrument similar in principle and somewhat similar in construction can also be applied to the indicating mercury column of the venturi meter so as to obtain proper volume correction.

The volume corrector applied to the impact-float constant-volume governor is shown in Fig. 1. The scale beam B, instead of having vertical calibration lines for standard conditions of air, has sloping constant-volume lines engraved upon it. The volume corrector proper is mounted on the front of the sliding weight W.

Fig. 2 shows the arrangement of this instrument. There are three milled heads, A, B and C, provided for

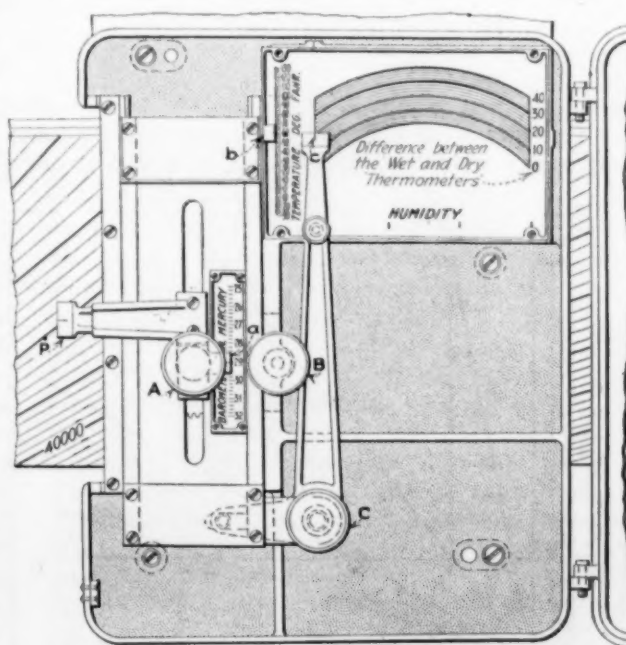


FIG. 2. INTERIOR CONSTRUCTION OF CORRECTOR

*Abstract of a paper presented at the annual meeting of the American Institute of Mechanical Engineers, December, 1917.

adjusting pointers indicating barometer, temperature and humidity. All that is required of the operator is to set these pointers correctly. After obtaining the actual barometer reading from a standard barometer, and the actual temperature of the incoming air, and observing the existing humidity—which is usually done by noting the temperature difference between a wet- and dry-bulb thermometer, pointer *a* is set at the proper barometric reading, pointer *b* at the proper temperature reading, and pointer *c* moved so as to intersect the curve corresponding to the observed temperature difference between the wet- and dry-bulb thermometers.

The movement of each of these pointers influences the final position of the main pointer *P*. This main pointer moves in a vertical direction with respect to the scale on the beam. After the volume corrector is properly set, the sliding weight to which the volume corrector is permanently attached is moved horizontally along the beam until the main pointer *P* intersects the sloping line on the graduated scale designating the proper volume of standard air required. When so set the sliding weight is in the proper position. This permits corrections to be made for variation in temperature, barometer and humidity so that a constant weight of oxygen is supplied no matter what the conditions of the atmospheric air. Having determined that the blast furnace requires a definite volume of standard air (dry air at 60 deg. Fahr. and 29 in. Hg), the governor with corrected setting of the sliding weight will deliver the proper amount of actual air which would contain the same weight of oxygen as would be contained in the required quantity of standard air.

PRINCIPLES OF THE CORRECTOR

The amount of oxygen in dry air varies directly as the density of the air. The density of air is directly proportional to the barometric pressure and inversely proportional to the absolute temperature. Expressed symbol-

ically, $\gamma \propto \frac{B}{T}$. As the float force is proportional to

M'

—, a change in density γ with the governor set to maintain a constant weight M of air per second will cause the governor to change the speed of the compressor until a new weight M_1 is delivered, such that the new

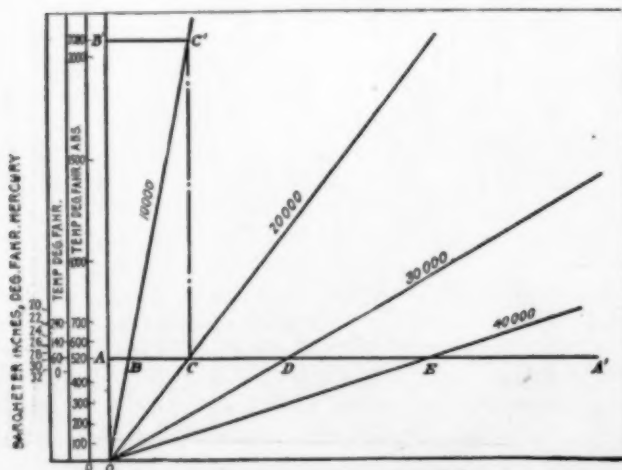


FIG. 3. METHOD OF GRADUATING BEAM

value of $\frac{M_1}{\gamma_1}$ is the same as the original value of $\frac{M}{\gamma}$. Expressed symbolically, for a given setting of the sliding

weight $M' \propto \gamma$, or $M \propto \sqrt{\frac{B}{T}}$. For moist air the barometer no longer represents the pressure of the air itself, for part of the barometric pressure is due to the vapor pressure in the air. This vapor pressure must therefore be subtracted from the observed barometric pressure in order to get the net air pressure to be used in computing the air density and hence the weight of oxygen per cubic foot of air. For saturated air (a relative humidity of 100 per cent) the vapor pressure can be read directly from steam tables for the observed atmospheric temperature. If the air is not quite saturated the relative humidity, or the percentage of the possible maximum of moisture in the air, can be determined in a number of ways; usually, from a dry- and wet-bulb thermometer arrangement. The vapor pressure for a given temperature is proportional to the relative humidity, and this must then be subtracted from the observed barometric pressure in computing the air density.

The graduated scale on the beam of the constant-volume governor was designed by taking a horizontal base line such as shown schematically in Fig. 3 as AA' , and placing thereon the proper calibration for standard air (dry, 60 deg. Fahr., 29 in. Hg.). The zero on this line gives the position of the sliding weight when the constant-volume governor beam is in equilibrium and no air is flowing. The point *B* (Fig. 3) represents the position of the sliding weight for 10,000 cu. ft. flow; and point *C* its position for 20,000 cu. ft. flow, etc. The distance AC is made equal to four times AB . Similarly the distance AD , where *D* represents the 30,000 cu. ft. point, is made equal to nine times AB . With respect to temperature, the graduations on the AA' hold good so long as the prevailing atmospheric temperature is 520 deg. Fahr. absolute. When the prevailing temperature is other than 520 deg. Fahr. absolute, the relations of the distances AB , AC , AD to each other remain unchanged; but they must all be multiplied or foreshortened by the same ratio. This is accomplished in the following manner:

Referring to Fig. 3, let the line OAB' be perpendicular to the base line AA' ; and let OA represent to some scale 520 deg. Fahr. absolute, and OB' represent 2080 deg. Fahr. absolute to the same scale, so that $OB' = 4 OA$. Draw $B'C'$ parallel to AA' and CC' parallel to OB' . Also prolong the straight line OB until it intersects the line $B'C'$ in the point *P* (not shown). The triangles OAB and $OB'P$ being similar, $B'P : AB :: OB' : OA$; or $B'P = 4 AB$. But $B'C' = AC = 4 AB$. Therefore $B'P = B'C'$; or *P* coincides with *C'*. In other words, the intersection *C'* of the line CC' with $B'C'$ is a point on the straight line OB .

Now in actual operation, when the governor is set to deliver 20,000 cu. ft. of standard air per minute for a temperature of 520 deg. Fahr. and should the actual temperature be four times as high, or 2080 deg. Fahr. absolute, the governor will, as explained before, with the same setting of the sliding weight, regulate for only 10,000 cu. ft. of standard air per minute, because the density of the air at 2080 deg. Fahr. absolute is one-

fourth of that at 520 deg. Fahr. absolute. The pointer of the sliding weight must under those conditions then read 10,000 cu. ft. without the sliding weight itself being disturbed in any way. In the volume corrector this would be accomplished by pushing up the final pointer along a uniform temperature scale until it reads 2080 deg. Fahr. absolute, because the pointer traveling upward would then, as proved above, just intersect the 10,000 cu. ft. line *OBC*. It will be noticed that all the sloping lines representing definite volumes of air per minute meet at *C*. This would represent the point of absolute zero if the same temperature scale was carried down on the prolongation of the line *AB*. From the above it can be seen that if the volume corrector be made to carry a temperature scale with the same distances as employed in the engraving of the scale on the beam, and the main pointer *P* of the volume corrector be made to move vertically up and down the proper distance to this scale, the sliding weight can be set for any observed temperature of atmospheric air so as to deliver the proper volume of air containing the same weight of oxygen as is contained in the previously calculated necessary volume of air of standard conditions.

Further consideration will show that as far as the density or the square of the volume is concerned, doubling the absolute temperature is equivalent to halving the barometer. In other words, any barometric change can be expressed by an equivalent temperature change. For instance, if 29 in. Hg is taken as the standard barometer and 60 deg. Fahr. (520 deg. absolute) as the standard temperature, a change to 28 in. barometer, the temperature remaining at 60 deg. Fahr., is equivalent

$$\frac{29 \times 520}{28}$$

to a change to a temperature — or 538.6 deg. Fahr. absolute (78.6 deg. Fahr.) with the barometer remaining at 29 in. Hg. The distance on the barometer scale from 29 in. to 28 in. must, therefore, equal the distance from 60 deg. Fahr. to 78.6 deg. Fahr. on the thermometer scale, whereas the correction necessary from 29 in. Hg to 25 in. Hg barometer is equivalent to

$$\frac{29 \times 520}{25}$$

a change to a temperature of — or 603.2 deg.

Fahr. absolute (143.2 deg. Fahr.) with the barometer remaining at 29 in. Hg. The distance on the barometer scale from 29 in. to 25 in. must therefore equal the distance from 60 deg. Fahr. to 143.2 deg. Fahr.

The barometric scale constructed on the above principle for the volume corrector is evidently a reverse and reciprocal (that is, non-uniform) scale. For constructional reasons, and chiefly to take care of humidity corrections explained later, it is desirable to have this scale uniform without affecting in any way the accuracy of the instrument. This is accomplished in the following manner:

Referring to Fig. 4, which gives a view of the volume corrector shown in Fig. 2, but with some of the front cover plate removed, *A*, *B* and *C* are the pins to which the milled heads *A*, *B* and *C* are attached. The main pointer in Fig. 2 is moved up and down in a vertical slot by means of pin *p* in Fig. 4. When the operator moves milled head *A* so that pointer *a* indicates the barometer reading, gearwheel *D* (Fig. 4) rotates about pin *A* because it is meshed into a rack *E* which remains

stationary. Motion is given to pin *p* (which is held in vertical slot) by the slot *S* in gearwheel *D*. This slot is in the form of a cam and so designed that pin *p*, and therefore the main pointer *P*, moves the proper distance vertically. The main pointer will move a less distance vertically when barometer pointer moves from 32 in. to 31 in. than it will when moving from 31 in. to 30 in., and less from 31 in. to 30 in. than it will from 30 in. to 29 in. Therefore, although the barometer scale over which pointer *A* moves has uniform divisions, the actual vertical distance through which the main pointer *P* moves is non-uniform and follows a reciprocal scale.

The setting of temperature is accomplished through

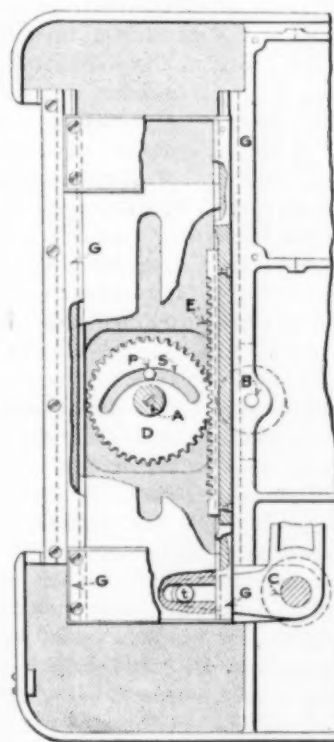


FIG. 4. INTERIOR END OF REGULATOR

milled head *B*, which is attached to a plate movable vertically between gibs *GG* and which carries with it the rack *E*, gearwheel *D*, and pin *p* with main pointer *P*. Moving *B* up and down does not revolve gearwheel *D* at all (that is, does not disturb the barometer setting), but simply moves main pointer *P* over a temperature scale shown in Fig. 2. Pointer *b* is set opposite the proper temperature reading.

The corrections for humidity in the volume corrector are based upon the following considerations: The barometric - pressure reading as usually observed is equal to the sum of the air pressure plus the vapor pressure. If the air is

saturated, that is, if it contains all the water vapor it is capable of holding without precipitation at the particular temperature, the value of the vapor pressure at the given temperature can be ascertained experimentally or taken from the steam tables. If the degree of saturation or the relative humidity is, say, only 20 per cent or 50 per cent, then the vapor pressure as determined experimentally must be multiplied by 0.20 or 0.50 as the case may be.

The most usual method of ascertaining the relative humidity of the air is by means of a wet- and dry-bulb thermometer arrangement. In its simplest form it consists of two similar thermometers, the bulb of one of which is covered by a wet piece of sponge. If the air is fully saturated no evaporation into it can take place and the two thermometers record the same temperature. When the air is only partly saturated, the evaporation from the wet bulb lowers the thermometer reading; so that the difference in the readings of the wet and dry thermometers can be taken as a measure of the relative humidity of the air. For any combination of relative humidity and atmospheric temperature the vapor pres-

sure is a definite quantity. This vapor pressure must be subtracted from the observed barometer reading in order to give the net or correct air pressure to be used on the barometer scale above described; since it is the density (and therefore the actual pressure) of the air alone that is of importance, and not the density of the mixture of air and water vapor.

It is important to note that the humidity correction in pounds per square inch or in inches of mercury is independent of the actual barometer reading, and depends only on the atmospheric temperature and on the difference between the wet- and dry-bulb thermometer readings (relative humidity). The humidity correction can therefore be made mechanically if the pointer *P* on the sliding weight is given an additional correction or movement which would be the equivalent amount of a certain subtraction of pressure on the barometric scale equal to the correction for the pressure due to vapor. It is for this reason that it is preferable to make the divisions on the barometric scale uniform, so that, for instance, a half-inch mercury correction would require the same movement no matter at what reading the barometer scale happened to be set. As will be shown later, the volume corrector accomplishes this, therefore no matter where the barometer pointer *a* is set, the humidity correction moves the main pointer *P* on the sliding weight the proper amount. It will also be noticed that the humidity is a function of the atmospheric temperature, that is, when the temperature is high the water vapor in the saturated air is higher than when the temperature is low. In the volume corrector the setting of the temperature pointer *b* on the temperature scale automatically sets the humidity pointer *c* to the correct temperature also.

Referring to Fig. 2, the correction for humidity is made by loosening milled head *C* and swinging pointer *c* until it intersects or indicates the proper amount of difference in reading between the wet- and dry-bulb thermometer. The movement of the long arm carrying pointer *c* about the center of milled head *C* moves pin *t* attached to a plate carrying gearwheel *D*, but does not move rack *E*. Moving gearwheel *D* vertically up or down rotates *D* because *E* is stationary and thereby moves the main pointer *P* similarly, as heretofore described.

ACCURATE CONSTANT-VOLUME GOVERNING

The volume corrector therefore is an instrument which can be set by an operator at the existing barometer, temperature and humidity of the atmospheric air, and when so set will permit the setting of the sliding weight on the scale beam in a position so that the constant-volume governor will hold or deliver the correct volume of air which would contain the same weight of oxygen as would be contained in a certain predetermined and desired volume of standard air.

This means that the blast-furnace operator, knowing the chemical compositions of the coke and iron ore and the amounts charged to the furnace in a stated period of time, can determine the exact volume of standard air (dry, 60 deg. fahr., 29 in. Hg) which will contain the proper amount of oxygen necessary for combustion of the coke and reduction of the iron ore on the blast furnace. He need not perform any mathematical calculations as to how much more or how much less air must be supplied when the atmospheric conditions are

not those considered standard in order to be sure the blast furnace is receiving at all times its exact and necessary weight of oxygen.

The volume corrector needs resetting every time the operator notices any change in the barometer, temperature or difference between the wet- and dry-bulb thermometer reading in order to be sure of securing the most efficient regulation. The air conditions, however, do not vary rapidly and the practice of inserting in an engine-room log every half hour the steam pressure, r.p.m., vacuum and other information can easily be extended to include readings of the barometer, thermometer and wet- and dry-bulb instrument. Even with the front cover of the volume corrector closed, transparent places are provided which will permit any one checking or observing these settings. The need of a volume corrector is apparent from the fact that it is possible to have a variation of weight of oxygen delivered to a furnace of 5 to 10 per cent ordinarily and in extreme cases as high as 20 per cent as a result of variations in atmospheric-air conditions, especially as between winter and summer. The gains in quality and quantity of output of a blast furnace obtained even by the former methods of constant-volume governing without volume corrections will be still further improved by the use of constant-volume governing with proper volume corrections.

West Lynn, Mass.

Close Watch on German Trade Preparations.—German preparations for trade after the war are being scrutinized carefully by experts in the Bureau of Foreign and Domestic Commerce, and the recent important report on the subject of "German Foreign Trade Organization," by Chauncey D. Snow, which touched on this point, has been in great demand. Since the war eliminated Germany from world trade, the United States has improved its position in foreign markets in spite of the shipping shortage and other abnormal restrictive factors. Department officials point out that the future prosperity of the country will depend in part on Germany's loss of good-will in practically all foreign markets and in part upon American ability to maintain our new prestige. American business must not make the mistake of seeing only one side of this situation and thus underestimating the German capacity for foreign trade or the energy, application, and craft with which German business will address itself to the task of regaining favor in markets in which it once prospered. In order to understand the significance of the information on German trade moves that will from time to time be made public, Secretary Redfield counsels not imitation of but familiarity with the German theories of foreign trade and the artful and formidable organization that, with Government aid at every turn, has been built up in Germany during the last twenty years to dominate the world's markets. It was to meet the demand for such information that the Bureau of Foreign and Domestic Commerce issued the bulletin on "German Foreign Trade Organization." The unprecedented demand for it is taken as an indication that the American manufacturer is making after-war preparations of his own. The Bureau now plans to get out about the first of the year a supplementary bulletin on German trade and preparations for the commercial future.

Bibliography on the Extraction of Potash

From Complex Mineral Silicates, Such as Feldspar, Leucite and Glauconite (Greensand Marl)

By E. C. BUCK

LESS progress has been made in the production of potash from silicate rocks than from other natural resources, such as brines and kelp. Nevertheless, a vast amount of work has been done on the subject and numerous processes have been patented. It is believed that the following bibliography will prove timely. It includes all references to patents and periodical literature relating to the sintering of phosphatic rocks with feldspathic rocks—a process which is held to be of great promise, since the potash is at once obtained in combination with the phosphoric acid. Other methods and processes have been included without partiality, and the list is practically complete.

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J. Soc. Chem. Ind., 1914, vol. XXXIII, no. 12, p. 644.

(To be concluded)

Synopsis of Recent Metallurgical and Chemical Literature

The German Chemical Industry.—*The Chemical Trade Journal and Chemical Engineer* (London) prints an interesting editorial in its Nov. 17, 1917, issue on recent developments in the large chemical companies in Germany. It is stated that a German report says that transactions on the Berlin Stock Exchange have recently been particularly active in shares of the companies engaged in the heavy chemical industry, with large upward movements in the quotations. In connection with this state of affairs rumors are in circulation to the effect that the question of largely increasing the share capital is engaging the attention of the leading concerns which entered into the enlarged community of interests in May, 1916, when the ordinary share capital of the three leading firms in the community—the Farbwerke Höchst, the Badische Anilin und Soda Fabrik, and the Farbenwerken vorm. Bayer & Co.—was rendered uniform on the basis of £2,700,000 each. No information appears to be forthcoming at present as to the projected capital augmentation, but it is considered probable that some such scheme is definitely proposed, having regard to the large extensions of the plants which are reported to have been carried out during the course of the war. A further factor in connection with the rumors is the statement that the present great community of interests is to be extended by the inclusion of other chemical firms.

The intention of the German Government to introduce compulsory syndicates, where such combinations do not exist and where voluntary efforts in this direction fail to accomplish the object in view, has now engaged the attention of the chemical industry. At the recent assembly of the Association for the Protection of the Interests of the Chemical Industry, which was held at Berlin, under the presidency of Dr. Hauser of Höchst, Dr. Riesser of Berlin, raised the question of the transition economy from war to peace work, and expressed his opposition to any compulsory syndicate in the chemical industry in that connection. If the central regulation of imports was inevitable, the chemical industry should be allowed to manage for itself and State limitation be restricted to supervision. It was necessary for freedom of trading to be restored to the fullest extent. The chemical firms, he said, desired to remain what they were—members of the creative class, without guardianship in their activity for the welfare of the country.

Effects of Heat on Celluloid.—The Bureau of Standards has recently issued Technologic Paper No. 98 by H. N. STOKES and H. C. P. WEBER on the effects of heat on celluloid and similar materials. The general conclusions from the work are as follows:

1. Celluloid (using the term in its popular sense to include the pyroxylin plastics in general) does not differ essentially from nitro-cellulose. The difference is one of degree and not of character. Nitrocellulose exists and reacts in celluloid as such; that is, as a solution of nitrocellulose in camphor or other solvent present, rather than as a new chemical compound.

The admixture up to 20 per cent of zinc oxide does not decrease the rate of decomposition of the nitro-cellulose in celluloid, the results seeming rather to show that there is an increase.

2. The decomposition of nitrocellulose in celluloid commences in the neighborhood of 100 deg. C. Above this temperature the heat of decomposition may raise the temperature of the mass to the ignition point, if loss of heat by radiation is prevented.

3. Above 170 deg. the decomposition of celluloid takes place with explosive violence, as with nitro-cellulose.

4. The rate of combustion is five to ten times that of poplar, pine, or paper of the same dimensions and under the same conditions.

5. Celluloid articles may be ignited by momentary contact with bodies having a temperature of 430 deg. or above, i.e., temperatures below visible red heat.

6. In spite of wide differences between individual samples, no essential differences were found between the celluloids of American manufacture, nor between articles of American and foreign manufacture, nor between manufactured and unmanufactured articles.

7. The general qualities of celluloid as to stability may be best expressed by a time-temperature curve, taking the time necessary for exploding small samples at several temperatures, say 170 deg., 180 deg., 200 deg. and 220 deg.

8. The vapors evolved by decomposition are poisonous and extremely combustible and may be ignited by the heat of decomposition of the celluloid itself.

9. The decomposition of celluloid is autocatalytic, and while not necessarily explosive may readily approach that condition as a limit.

Chemically Pure Bismuth.—Bismuth at present is commercially manufactured with a purity of 99 per cent, and for all ordinary purposes this is sufficient. However, in the manufacture of electric and magnetic measuring instruments, for which bismuth is used in ever-increasing quantities, a much purer metal is required. M. MYLIUS and E. GROSCHUFF describe a very satisfactory process of refining bismuth, in the *Zeitschrift für Anorganische Chemie*.

The authors call attention to the fact that while a 99 per cent pure metal is obtained fairly easily, the remaining 1 per cent of impurities holds so tenaciously as to make its removal somewhat difficult. By heating the nitrate of bismuth, $\text{Bi}(\text{NO}_3)_3 + 5\text{H}_2\text{O}$, the oxide is formed and this can be reduced by hydrogen. The residue is melted and crystallized. The plan to purify bismuth by distillation does not work out in practice, as most of the impurities remaining after the ordinary refining process boil at a temperature of less than 1500 deg. Cent., which is the temperature of boiling bismuth.

The method described above is stated to yield a metal which does not contain more than 0.01 per cent of impurities and which melts at 271 deg. Cent. Wire of 1 mm. diameter has an electric resistance of 1.20 ohm. at 22 deg. If the percentage of impurities amounts to 0.1 per cent the resistance value is 3 ohms.

The Determination of Titanium in Ferro-Titanium.—An improved method of analyzing volumetrically the quantity of titanium in ferro-titanium has been discovered by G. ROEHL and described in the *Chemiker*

Zeitung. It is an improvement of the titration method evolved by Knecht and consists of the following operation: The strongly acid solution of ferro-titanium is reduced to a titanium chloride solution by the use of zinc and a current of CO_2 . This reduced solution is then titrated with a hot solution of FeCl_3 in the presence of several drops of methylene blue. The color change is extraordinarily sensitive.

As the most satisfactory proportions the author recommends that 0.5 gram of the finely pulverized product be treated with 5 to 6 times its own weight of "Eschka alloy" to melt this mixture and then drop on it a very small quantity of water. Dissolve the whole by boiling in 200 cc. of concentrated hydrochloric acid. The solution is poured into a vessel of larger contents and water is added to make 500 cc., 100 cc. being used for each titration. To each 100 cc. is added 60-70 cc. of concentrated HCl and 4 or 5 zinc granules. A current of CO_2 is sent through the solution. When the reduction is complete the current of CO_2 is shut off, methylene blue added and the solution titrated with a hot solution of FeCl_3 of accurately known strength, tested on solutions of titanium oxide (TiO_2) prepared for that purpose.

Synthetic Rubber.—The Catalyst, official organ of the Philadelphia Section of the American Chemical Society, gives an abstract of an address delivered before the Section by Dr. FREDERICK DANNERETH of Newark, N. J., on the "Financial Prospects of Synthetic Rubber."

In his introductory remarks, Dr. Dannereth referred to the various attempts which have been made in England and America since 1909 to float companies for the manufacture of synthetic rubber. Many of these bore a close resemblance to stock-jobbing propositions. The only bona fide processes thus far recorded, and which actually demonstrated progress in the art, were those of the Synthetic Products Co. of England and the chemical works at Elberfeld and Ludwigshafen. The English company is at present handicapped by its overproduction of butyl alcohol, but if a new use were discovered for this material the process would at once become of exceptional interest.

Among the names prominently associated with the synthetic or laboratory production of rubber Dr. Dannereth mentioned those of Perkin, Harries, Matthews, Hofmann, Strange, Coutelle and Fernbach. Many more could be added to this list, but these are the men who have done much of the fundamental work. Mention was made of the fact that if the United States were suddenly cut off from its rubber supply it would cost the American rubber industry over \$250,000 per day. Speaking of the raw materials required, he stated that the Strange-Fernbach process required starch, and this could be economically obtained from potatoes. An annual production of 10,000,000 lb. of rubber might require 500,000,000 lb. of potatoes grown on 50,000 acres of land. The starch is converted by fermentation into acetone and butyl alcohol. Another process which has been suggested is based on the use of aldehydes and ethyl alcohol. Such a process would, if rational, make it possible to utilize our liquor distilleries in case of national prohibition. A process developed by the Badische Company is based on the use of acetone. This would be of very great interest to us, as we are in a good position to produce calcium carbide. A com-

pany has, in fact, just been formed for manufacturing this material in Virginia. The acetylene yields acetic acid and acetone. The acetone yields, on further treatment, pinacone, dipropylene, and dipropylene rubber. At the wholesale price of four cents per pound, calcium carbide is one of the most attractive raw materials at the disposal of chemical manufacturers for the synthetic production of rubber. This fact was emphasized very strongly by Dr. Dannereth, and he indicated that this was at the present time the one process which should be given serious consideration by American chemists and investors.

The financial prospects of synthetic rubber will depend upon such factors as: The demand for rubber in the United States; the price that could be obtained for the product; the minimum price at which natural rubber can be sold in the United States; the competition which would be experienced from the natural product; the factory cost of the product; the particular process which is chosen; the extent of side products and waste products; the operation of incidental processes; the possibility of irregularities in the process; the ability to secure college-trained chemists and engineers; the price of the raw materials; the abundance of the raw materials; the regular supply of the raw materials; the protective action of an import tariff on crude rubber; the efficient conduct of the processes; the cost of labor and the choice of correct machinery and apparatus.

Reference was made to the fact that, according to a published statement in 1905, the Hoechst and Badische companies sold indigotin to dealers in Germany at 18 cents per pound. The total world-production of rubber in 1916, figured on a "washed and dried" basis, was estimated at 427,250,000 lb. In the same year the U. S. Customs House reported the total importation of all kinds of rubber at 267,000,000 lb.

Benzol as a Motor Fuel.—J. H. CLEGG of the Blackburn, England, Gas Company, recently presented some interesting data before the Manchester Gas Association on benzol recovery. According to the *Gas Record*, Dec. 12, 1917, Mr. Clegg thinks there will be a big demand for benzol after the war. In this connection the following remarks by Mr. Clegg as to the English situation are interesting:

"I think that it behooves every gasworks to install a benzol plant, apart from patriotic reasons, as I venture to anticipate a great demand for this production as a power fuel, in spite of the fact that gas will undoubtedly retain the field which it is now obtaining as a propellant of motor vehicles. Even compressed gas in cylinders is scarcely adaptable or safe for motor-cycles, of which there will be an enormous surplus at the conclusion of the war. Aeroplanes and airships will not by then be conveyances of the future, but will be well in evidence. Let us then aim to grasp the whole field of transport, either by gas, coke, or benzol. I have found by personal experience that benzol is more efficient than petrol, if the sulphur impurities are removed, and that the statement that the former coagulates the lubricating oil is not justified if a good quality oil is used. As for the cost of production, we know we can produce this commodity to compete favorably with petrol, for whatever the conditions existing for importation and distribution of the latter, like advantages or disadvantages apply to ourselves."

Recent Metallurgical and Chemical Patents

Coal-Tar Products

Production of Phenol.—HERBERT S. KIMBALL of Newton, Mass., patents a process of making phenol from benzol by a cyclical process. The patent is assigned to the Merrimac Chemical Co. of Boston, Mass. A complete cycle embodying the invention is shown on the accompanying diagram.

The present invention may be carried out as follows: The benzol is first sulphonated as usual, and the resulting sulphonic acid compound, containing an excess of sulphuric acid, is wholly or partly neutralized by calcium sulphite, utilizing for this purpose the calcium sulphite which is produced at a later stage of the cyclical process, as explained below. The neutralization is effected in closed tanks, and the evolved sulphur dioxide, or such portion thereof that may be required, is employed to decompose the sodium phenolate, as described in the above mentioned application. In case the quantity of calcium sulphite available is insufficient for complete neutralization of the sulphonic acid compound, it is supplemented by lime or limestone.

The calcium benzol sulphonate prepared as above is treated with the molecular equivalent of sodium sulphite, and is thereby transformed into sodium benzol sulphonate. The sodium sulphite may be introduced either in solution or in solid form into the solution of calcium benzol sulphonate, and the calcium sulphite which separates out is applied toward the neutralization of the sulphonic acid compound produced in the first step of the process.

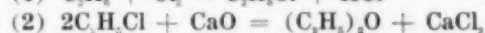
The sodium benzol sulphonate is now subjected to a caustic fusion to produce sodium phenolate, which in turn is decomposed by sulphur dioxide (undiluted) arising from the neutralization step of the process. The phenol is decanted, and the remaining liquor, containing sodium sulphite or bisulphite, or a mixture of these, is utilized in part for the conversion of the calcium benzol sulphonate into the corresponding sodium salt, as above described, and is in part causticized by lime, yielding a

dilute caustic soda solution and calcium sulphite, the latter available for neutralizing the benzol sulphonic acid. If desired, the caustic soda solution may be concentrated and returned to the cycle. (1,245,353, Nov. 6, 1917.)

Production of Phenol.—In a patent granted to HENRY HOWARD of Brookline, Mass., the sodium phenolate prepared as usual by the caustic fusion of the sulphonic body, is decomposed by sodium bicarbonate, preferably employed in the proportions required to transform all of the sodium, whether present as phenolate or as caustic soda associated with the phenolate, into normal sodium carbonate. Under these conditions the reaction is stated to be very rapid, and even practically instantaneous. The reaction will proceed at normal and higher temperatures, and is exothermic; 60 deg. C. is a satisfactory operating temperature, although either higher or lower temperatures may be used. There are no fixed upper or lower limits for the concentration of the phenolate solution, but a concentration in the neighborhood of 23 deg. Baumé is satisfactory in practice. To avoid unnecessary dilution, the bicarbonate may be added to such solutions in solid form, although this is not essential. Most of the phenol rises to the surface of the liquid, and may be separated by decantation, the remainder being recovered from the carbonate solution in any appropriate way, as, for instance, by distillation, or by blowing steam through the liquid. About one-half, or somewhat less, of the sodium carbonate solution produced as above, is now treated in any suitable apparatus with the lime-kiln gas, and is thereby reconverted into sodium bicarbonate, which is used for the treatment of another batch of sodium phenolate. The remainder of the sodium carbonate solution is causticized by lime, and may be concentrated for re-use in the preparation of the phenolate, or applied to any other purpose. (1,245,343, Nov. 6, 1917.)

Miscellaneous Chemical Processes

Paraffin Ethers.—The manufacture of paraffin ethers such as ethyl ether is the subject of a patent of BURRITT S. LACY of Sewaren, N. J., assigned to the Roessler & Hasslacher Chemical Co. of New York. The following reactions illustrate the manufacture of ethyl ether:



It was found that under certain conditions the formation of ethers as exemplified by reaction (2) may be successfully carried out and with nearly quantitative yields. In connection with this fact it was found especially in working on a large scale, that the highly exothermic character of reaction (2) presents a serious difficulty due to the tendency to rapid decomposition and carbonization brought about by the heat of reaction itself. It was furthermore found, however, that this unfavorable heat evolution may be wholly neutralized and the reaction made entirely successful even on a large scale by means of admixture with the ethyl chloride of a large amount of an inert gas.

Any one of a number of inert gases, for example nitrogen or methane may be employed, but it is preferable to use the excess C_2H_6 , which is already present with the $\text{C}_2\text{H}_5\text{Cl}$ when prepared according to reaction (1) as described in copending application Serial No. 852,164 filed July 21, 1914, for the manufacture of ethyl

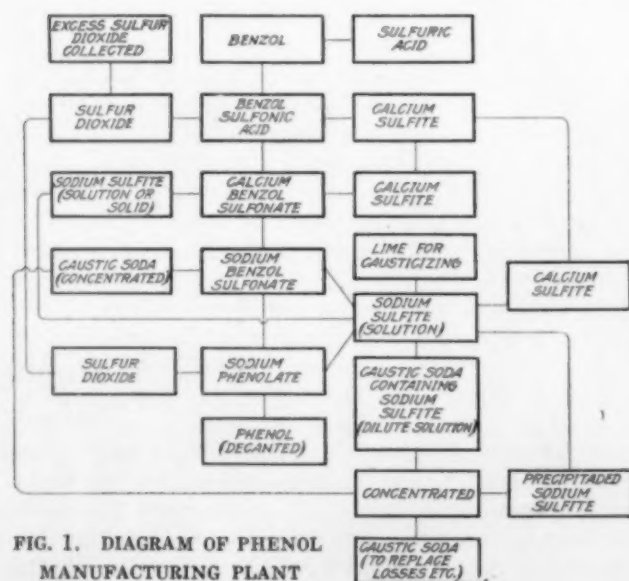
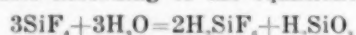


FIG. 1. DIAGRAM OF PHENOL MANUFACTURING PLANT

chloride since the process then becomes a continuous cycle with production of substantially only HCl, ethyl ether, and CaCl₂, without the necessity of first separating the C₂H₅Cl as such.—(1,245,742, Nov. 6, 1917.)

Salt Cake and Nitre Cake in Making Silicofluoride.—KARL F. STAHL, of Pittsburgh, Pa., patents a process of treating phosphate rock for the production of sodium silicofluoride from the fluorine and silicic acid contained. Phosphate rock contains some fluorine as calcium fluoride and silicic acid either free as silica, or combined as silicates. In the process of making acid phosphate for use as a fertilizer the ground phosphate rock is mixed with sulphuric acid which has previously been diluted to the required strength. This converts the tertiary calcium phosphate into primary phosphate, rendering it soluble in water, but it also liberates the fluorine of the calcium fluoride, forming hydrofluoric acid. This acid in turn combines with the silica forming principally silicon fluoride (SiF₄), which, as a gas, escapes into the air and is detrimental to surrounding property. In order to prevent the escape of this gas, the silicon fluoride is brought into contact, in suitable apparatus, with sprays of water, and this decomposes the silicon fluoride into hydrofluosilicic acid and silicic acid according to the equation:



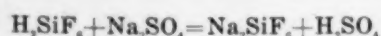
The hydrofluosilicic acid is immediately absorbed in the water in which the silicic acid remains suspended. The two are separated by means of a filter press and the hydrofluosilicic acid is converted into sodium silicofluoride, a useful product, by means of a solution of sodium chloride, according to the equation:



This leaves a weak solution of hydrochloric acid which is of little value and cannot be utilized in the process. In locations where there is no large body of water it is necessary to make some arrangements for the disposal of this weak solution of hydrochloric acid which is produced in considerable quantity. This problem becomes very difficult in some cases and practically prohibits the erection of a plant for the production of sodium silicofluoride where such plant would otherwise be most favorably situated.

One of the objects of the present invention is to provide an improved process for treating phosphate rock in which resulting products of value or ones which may be easily disposed of are produced. Another object is to provide an improved process for treating phosphate rock in which the product resulting from the conversion of hydrofluosilicic acid into sodium silicofluoride may be utilized in the process of treating the rock.

The phosphate rock, according to the improved process, is treated with sulphuric acid which renders the phosphate soluble in water and produces hydrofluoric acid. This acid combines with the silica, forming principally silicon fluoride (SiF₄), which afterward is decomposed into silicic acid and hydrofluosilicic acid and this latter acid is then absorbed in water. Instead of treating this solution with sodium chloride, it is treated with a solution of sodium sulphate which precipitates sodium silicofluoride according to the following equation:



The sodium silicofluoride is sparsely soluble in water or in dilute sulphuric acid, and consequently is thrown down as a fine powder or sludge, which is separated from the liquid by a suitable filtering device, such as a filter press or centrifugal machine. It is then washed free of acid, dried and ground, whereupon it is ready for shipment.

The dilute sulphuric acid which is produced by this reaction may be utilized in the process of treating the phosphate rock so that no provision need be made for the disposition of large quantities of waste acid liquid. For the purpose of acidulating the phosphate rock in the initial reaction sulphuric acid of 50 deg. Baumé, is generally used. In the usual chamber process of making sulphuric acid the latter is usually produced stronger than 50 deg. Baumé and to use it for acidulating phosphate rock it is diluted with water to reduce its strength. In the present process, instead of diluting this acid with water, it is diluted with the sulphuric acid solution obtained in the final stage of the process. Such solution generally contains sulphuric acid in a dilute state of about 7 deg. Baumé. The acid solution resulting from the process is thus not only disposed of but it is utilized in the treatment of the phosphate rock. Sodium sulphate and acid sulphate may be obtained in the form of salt cake and nitre cake respectively, which are waste products from the manufacture of hydrochloric and nitric acid. They are relatively inexpensive and often contain some free sulphuric acid. In such case more sulphuric acid or a stronger acid is obtained in the final stage of the process which may be used in treating the rock. The process thus enables the waste cake from the nitric or hydrochloric acid process to be used. In addition to disposing of the waste products from these acid processes, the use of such products in treating phosphate rock produces a resulting acid solution which may be again used in the initial step of treating the rock. The waste products of two processes are thus saved and the difficulty of disposing of them avoided. The sulphuric acid does not affect the apparatus for handling the precipitated sodium silicofluoride to as great an extent as the hydrochloric acid heretofore produced and therefore it is claimed renders the process more inexpensive by reason of the reduction in the replacements of apparatus. (1,247,165, Nov. 20, 1917.)

Acetaldehyde from Acetylene.—It is well known that acetylene may be caused to unite with the elements of water, yielding acetaldehyde, by bringing it into contact with a suitable compound of mercury in the presence of sulphuric acid. HAROLD HIBBERT of Pittsburgh, Pa., patents an improvement on processes of this general character and assigns same to the Union Carbide Co., of New York City.

According to the invention, acetylene is led into an acid bath of the general character above mentioned, in material excess of the amount which can be absorbed in the first reaction. The bath is preferably maintained at a temperature of 70 deg.—80 deg. C., whereby the bulk of the acetaldehyde formed is continuously distilled off, mixed with the excess of acetylene. These mixed gases are conveyed directly to a second acid bath, preferably having the same characteristics as the first, where a further reaction takes place. If desired, the commingled gases from this second bath, which by

reason of the further reaction will contain a proportionately smaller amount of acetylene, may be conveyed to a third bath, and so on to any desired number of series-connected baths. Ultimately a sufficiently complete absorption of acetylene, for example an absorption in excess of 75 per cent of the original volume, is secured. The exit gases from the final bath, consisting predominantly or substantially of acetaldehyde, are led to a condensing system, from which any residual acetylene may be returned to the first element of the absorption system, together with sufficient added acetylene to re-establish the desired excess. The rate of supply of acetylene to the system will depend upon several factors, including the number of vessels in series, the volume of the acid baths, and their conversion efficiency. Usually it is preferred to supply acetylene at such rate that some 50 per cent, more or less, of the gas entering the first absorption vessel will pass therefrom to the next in series. (1,247,270, Nov. 20, 1917.)

Iron and Steel

Sintering Ores.—A continuous sintering process for sintering fine ores, concentrates, etc., is patented by JAMES GAYLEY of New York City. The apparatus can be applied to lean magnetic ores containing from 30 to 40 per cent of iron and which are too fine for direct use when concentrated. Large scale operations are necessary in order to be profitable. One of the features of the present process is the possibility of treating layers several feet thick, whereas formerly only about 7 in. thickness could be treated on a continuous machine. The sides of the cars may be of any height desired and the number of idle cars is greatly reduced. In general the process consists in the employment of two parallel tracks, in substantially the same horizontal plane, over which the cars are adapted to be moved uniformly and continuously in reverse directions. Having reached the discharge end of a track each car is emptied of its sintered contents, transferred in any suitable manner to the return track, refilled with ore or other material, which is then ignited and sintered during the passage of the car to its original starting point, where it is again dumped, refilled and caused to travel in the reverse direction over the first track. Some of the advantages of the process as given in the patent specification are as follows:

"By far the largest proportion of materials which are sintered at the present time by the continuous process, rarely require for the best operative results a depth or layer in excess of 9 in., consequently, the sides of the cars or pallets are made low, and they have no upright ends at all. The cars are also carried on wheels that run on the tracks provided for that purpose, and at both ends they are so constructed or planed off that they will make tight joints when brought together in a train to prevent the leakage of air. It is further usual to provide on the sides of the cars wind seals, preferably composed of single bars free to move vertically in a slot in the car body and slide over the edges of the wind box. In the process of sintering herein described the cars are always held in an upright position, so that this or many other forms of wind seal may easily be applied and used.

"The advantage of using cars without upright ends follows from the fact that this provides for the operation being carried on as a strictly continuous one. The several cars are dependent in the sense that their ends contact to make close air-tight joints throughout the sintering train. The layer of sintering material which such cars support is, moreover, continuous, or uninterrupted throughout the sintering period. From this it results that the ignition of the layer is more uniformly and effectively performed, and carried out while the cars are in motion. When independent cars with side and end walls are used the ignition of the

charge takes place under a hood, the cars having the side and end walls of equal height to prevent leakage of the ignition flame, and it is required that each car remain stationary while the ignition of its charge is taking place.

"These stoppages of each car, in turn, stop the whole train and thereby render the process an intermittent one, curtailing the sintered output and imposing a variable load upon the suction fans through the variations in the percentage of the total sintering bed from time to time, thus producing at different times a variable suction pressure in different parts of the same, but disconnected sintering bed.

"The material which lies against the sides and ends of independent cars is, moreover, not so perfectly ignited, so that the elimination of ends reduces the area of imperfect ignition. Besides, the car with side and end walls makes the sintering layer disconnected, and it is not practicable to properly ignite a moving layer which may vary considerably in depth. For effective and economical ignition, the igniter must be close to the moving layer to produce the required heat concentration, but if for any reason a change occurs in the character of the material to be sintered, and a varying depth of the layer is required, it is not possible with independent cars to properly adjust the height of the igniter above the layer, as this is limited by the ends of the cars which must pass under the igniter, and in consequence the ignition and sintering of the layer is imperfect.

"In treating the same kind of material in a connected or continuous layer, the igniter can be placed in a fixed and proper position for that material and remain in such position, and this fact permits the use of a gas of low calorific power such as blast furnace gas, while intermittent ignition under a hood requires a high calorific and much more expensive gas.

"In sintering operations where independent cars are used and the charges ignited under a hood, the charging of the cars and the ignition of the material become manual and intermittent operations, whereas in the method or process as herein described, the only manual operations involved are the dumping and the transferring of the cars." (1,247,661 Nov. 27, 1917.)

Dolomite Refractory Brick.—JAMES O. HANDY and ROBERT M. ISHAM of Pittsburgh, Pa., patented a dolomite refractory brick and process of making same. The patent is assigned to the Allen S. Davison Company of Pittsburgh, Pa. In granulating calcined dolomite for making refractories for basic open hearth furnaces, considerable dust and fine material are produced. In the present patent it is proposed to use this dust for producing refractories, either alone or in mixture with other material. This waste dolomite is dead burned as it comes, and is afterward submitted to a brick-making treatment and another dead burning, producing strong, dense and refractory bricks. It is stated that they show no tendency to slack when placed in boiling water. For burning it is a matter of convenience to add more or less water to the dust to ball it up and form aggregates which can be handled in a rotary kiln; a rotary kiln being well adapted for this first burning. No other treatment is necessary. (1,248,486, Dec. 4, 1917.)

Rust-Proofing Iron and Steel.—A process of rust-proofing using vapors containing phosphorus compounds is patented by WILLIAM H. ALLEN of Detroit, Mich. The process consists in subjecting articles of iron and steel, properly cleaned by pickling or sand blast, to the fumes or vapors of phosphorus pentoxide or anhydride together with some aqueous vapor until surfaces of basic phosphates of iron are produced. These vapors may be produced in any desired manner, the preferred process consisting in subjecting a mixture of ground phosphate rock, coke and sand to a strong current in an electric furnace. The liberated phosphorus immediately changes to P_2O_5 , and these fumes are drawn into the processing chamber by means of a suction fan. The fumes may be first passed through a dust chamber. (1,248,053, Nov. 27, 1917.)

Temperature Regulator.—PORTER H. BRACE of Pittsburgh, Pa., patents a regulating device which is particularly applicable to the regulation of heat treating, motor speeds, pressure in tanks, etc. The patent is assigned to the Westinghouse Electric & Manufacturing Company. The apparatus includes a potentiometer conductor, a thermo-couple or generator that is subjected to the temperature of the device, the temperature of which is to be regulated or that is actuated in accordance with other varying conditions, such as speed, pressure or energy, and a galvanometer for controlling the operation of a potential regulator or other regulating device. The galvanometer is connected in series with the thermo-couple or generator, and the circuit, thus constituted, is connected to the potentiometer conductor. A periodically actuated cam device having a contour corresponding to the desired time-temperature or other predetermined curve is adapted to so change the connections of the series-connected circuit, with respect to the potentiometer conductor, that the galvanometer is adapted to control the potential regulator or other regulating device to cause the temperature, pressure, speed or energy to vary in accordance with the predetermined desired characteristics. (1,248,444, Dec. 4, 1917.)

New Holder for Drawings and Blue Prints

The accompanying photographs show a new holder for drawings, blue prints, specifications, etc., made by the National Company, 273 Congress Street, Boston, Mass. Fig. 1 shows the lock which is used for

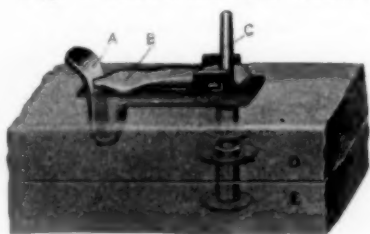


FIG. 1

holding the sheets and Fig. 2 shows the top string of the binder removed and print being taken from or added to file as desired. Referring to Fig. 1, the binder is locked by pressing on A. To release the

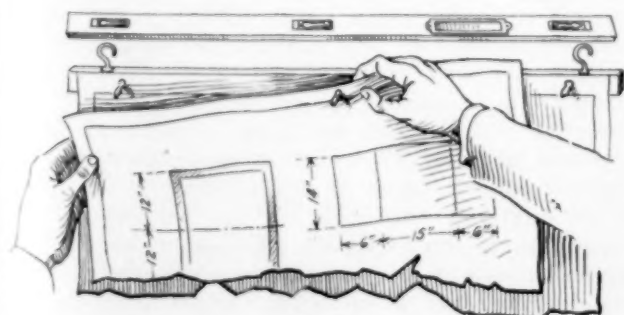


FIG. 2

binder the tongue B is pressed. This locks or releases B on hardened stud C, which is fastened into lower strip of oak-wood binder E.

The holder has a removable index card and will hold from one to sixty prints, without tearing or soiling.

Improved Quartz Mercury-Vapor Lamp for Ultra-Violet Light

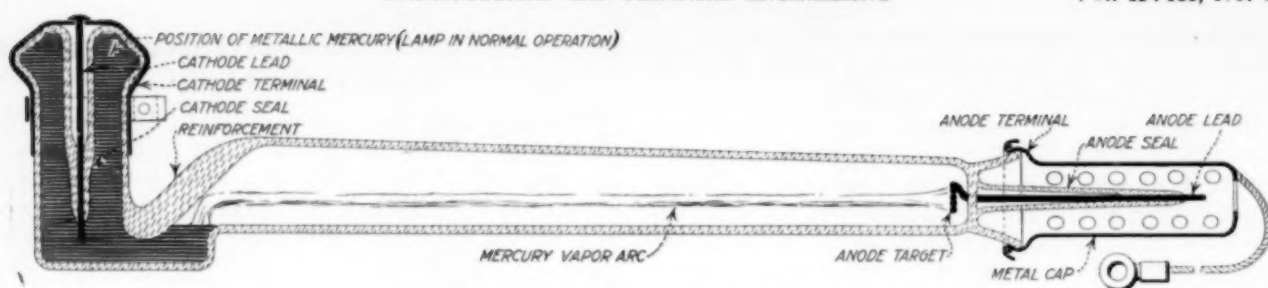
THE photochemical activity of invisible light waves existing beyond the visible violet of the spectrum has long been a recognized fact, and considerable research has been done to determine the nature and extent of the reactions produced. The shortest wave length of light perceptible to the eye is about $.3969\mu$, in the violet end of the spectrum. Rays of shorter wave-length vary in their activity and effect. Berthelot divided them into four groups: 1. Wave lengths 0.4 to 0.3μ , comprising the ultra-violet rays that reach the earth's surface in sunlight. These rays are similar to the violet rays of the visible spectrum. 2. Wave lengths 0.3 to 0.2μ , medium rays of strong photochemical effect, producing marked chemical and physical changes. 3. Wave lengths 0.2 to 0.15μ , useful in synthetic processes. 4. Wave lengths 0.15 to 0.1μ , comprising an ultra-violet region about which little is known.

Among the physical and chemical effects produced by ultra-violet light are many of practical value, affording quick tests for certain properties, and acceleration of certain chemical reactions. The sterilization of liquids such as water and milk, and of semi-solids like edible fats, is readily accomplished by ultra-violet rays. Exposure of only a fraction of a second under proper conditions is required for complete sterilization. Most dyes fade rapidly under treatment with ultra-violet light, and some remain fast. Fabrics like cotton, rubber, oil-cloth, etc., reveal in a comparatively few minutes the deterioration that otherwise would not become apparent for days in ordinary light. Numerous organic substances are bleached by its action.

Chemical reactions produced by ultra-violet light are many and varied. Chlorine derivatives of toluol are produced in greatly increased yields and without undesirable by-products if the reaction proceeds in the presence of ultra-violet rays. Other chlor-substitution organic products are formed with greater facility, in greater quantity and of higher degree of purity if ultra-violet light enters into the reaction. The halogen elements generally seem sensitive to this force and enter into synthetic reactions rapidly under its influence. Cyanogen is converted into para-cyanogen, sulphur and phosphorus show allotropism, organic compounds undergo isomeric changes, hydrolytic reactions are accelerated, and numerous other changes occur under influence of ultra-violet rays.

The production of these rays in a manner suitable for application in the arts has been the subject of considerable invention. They are given off in concentrated form from a mercury-vapor lamp, but since glass is impervious to them it is necessary to construct the lamp of quartz if the rays are to be used.

An improved form of quartz mercury-vapor lamp which embodies new features in construction and application is manufactured by the R. U. V. Company, New York City. This lamp produces an ultra-violet component several times stronger than that yielded by other forms of quartz mercury-vapor lamps. The wave lengths of its light have been measured as low as 0.18μ , indicating a high degree of activity according to Berthelot's classification given above.



IMPROVED LAMP FOR ULTRA-VIOLET RAYS

The shape of the lamp is shown in the accompanying drawing. It consists principally of an exceptionally clear crystal-quartz frame containing mercury, fitted at each end with terminals and provided with an unusually high vacuum. The cathode terminal of the lamp under running conditions contains practically all of the mercury, as the pressure built up in the luminous tube forces the mercury back into the cathode end. The anode end is fitted with a tungsten terminal that is refined to a point approaching 100 per cent purity in order to prevent discoloration of the luminous tube.

The seals consist of tungsten wire sealed to the tube by means of a graduated mixture of glass and quartz, so distributed as to present approximately 100 per cent quartz nearest to the luminous tube and 100 per cent glass at the outside end of the seal. This combination of glass and quartz provides proper coefficient of expansion to prevent loss of vacuum.

The luminous tube or that part of the lamp in which ultra-violet rays are radiated, extends from the reinforcement bend near the cathode end to the tungsten coil forming the anode terminal, and therefore presents a radiating distance approximately 6 in. long.

This type of lamp is known as the "hot anode" type and differs from all other designs in that no mercury chamber is used at the anode end. This feature permits of operation of the lamp in any plane from vertical to horizontal, and therefore permits of application to practically any form of equipment used by the chemical manufacturer.

The metal cap fastened to the anode end, and attached directly to a collar at the end of the luminous tube, prevents the anode seal from mechanical injury and provides as well a means for attaching the positive lead wire in such a way as to remove strain from the anode seal. The negative seal is protected from strain by soldering it with silver to a strap which passes over the top of the cathode end. It is held rigidly in place by a circular band fastened around the vertical bulb of the cathode end.

The cathode end of the luminous tube is reinforced with thick quartz to absorb the shock of the mercury-vapor arc which strikes against it, while the other end of the mercury-vapor arc terminates against the target formed by the coil of tungsten wire which is the anode terminal. It is considered that the angle presented by the reinforcement of the luminous tube to the mercury-vapor arc, is such as to reflect back into the luminous tube some ultra-violet light that otherwise would escape.

To start the lamp the luminous tube is placed in a horizontal plane which permits the flow of mercury across it, so connecting the anode and cathode terminals, and immediately after the current is supplied

to the lamp the anode terminal is tilted upward to strike or draw an arc. In a short time thereafter sufficient temperature and pressure is built up inside the luminous tube to produce the maximum amount of ultra-violet of which the lamp is capable.

To support this mercury-vapor arc, as in the case of all mercury-vapor arcs, ballast resistance is required, and such resistance is placed in series. When the lamp is started cold, about 20 ohms resistance is placed in series, but when the lamp is normally operating, one-half of this resistance is cut out so that normally 10 ohms is constantly in series with the lamp terminals. This cutting out of resistance is accomplished automatically on a small switchboard that is provided as an accessory to the lamp.

The starting characteristics of the lamp are therefore 8.5 amp. at 220 volts D.C., which is required normally for 10 to 15 min. As soon as the starting resistance of 10 ohms is cut out, the lamp, then being in normal running condition, consumes 3.5 amp. at 220 volts D.C.

Insulation Test on Steam Drums

An interesting test for determining loss of heat by radiation from boiler settings and steam drums was recently made by Mr. C. A. Eastwood, Superintendent of Station A, Pacific Gas and Electric Company, San Francisco, Cal. For his experiment Mr. Eastwood selected a 560-h.p. B. & W. boiler, the steam drums of which were covered with one course of common brick. A rectangular can containing a measured quantity of water was placed on top of one drum and the boiler was run at its rated capacity for a period of three days. During this time the rise in temperature of the water was carefully noted, and with these data it was a comparatively simple matter to determine: (a) the amount of heat radiated per square foot of surface per hour; (b) the amount of heat radiated from the total exposed area of the drums, and (c) the quantity of fuel which was being burned to make up for this loss. Mr. Eastwood's figures showed that the loss totaled 390 barrels of oil per year.

To determine how much of this fuel-loss could be saved by the use of an effective heat insulating material, one 2½-in. course of nonpareil insulating brick (Armstrong Cork & Insulation Company, Pittsburgh, Pa.) was then placed on top of the common brick covering, and readings were taken as in preceding tests. The result showed that with the nonpareil brick in place the loss of heat amounted to only 144 barrels of oil per year. With oil costing 70 cents per barrel, the saving amounted to more than enough to pay for the cost of the insulating brick and the labor required for installing them.

The total amount of heat lost represents that radiated from the steam drums alone. Had the radiation from the exposed boiler walls been included as well, the total heat-loss would have been greatly increased. Furthermore, if the common brick had been removed entirely and replaced with a coarse nonpareil brick set on edge, giving $4\frac{1}{2}$ in. of insulation instead of $2\frac{1}{2}$ in., a still greater saving would have been effected, since, according to the manufacturers, nonpareil brick are ten times better heat insulators than either common brick or fire brick.

Personal

MR. L. DOUGLAS ANDERSON, superintendent of the Midvale, Utah, smelter of the United States Smelting Co., has been appointed manager of smelteries for the company at Salt Lake City, Utah. The company is a subsidiary of the United States Smelting, Refining and Mining Company.

MR. H. A. BAKER, chief chemist of the American Can Co., has gone to Washington to act on the committee on conservation of tin plate.

Professor CHARLES BASKERVILLE, Professor of Chemistry and Director of Laboratories of the College of the City of New York, delivered a lecture at the Royal Canadian Institute, Toronto, Canada, December 8th, the subject being, The Hydrogenation of Vegetable Oils.

MR. WARREN F. BLEECKER, of Boulder, Colo., spent a few days in New York during Christmas week.

MR. C. L. BRICKMAN was recently appointed chief chemist by the Rex-Hide Rubber Manufacturing Company, East Brady, Pennsylvania. Mr. Brickman comes from the Research and Development Laboratories of the U. S. Rubber Company.

MR. E. J. CARLYLE and Mr. M. R. HULL have recently returned from Russia. Mr. Carlyle is manager and Mr. Hull, engineer, of the Sissert Mining Company, which operates a large concession in the Ural Mountains, near Ekaterinberg, mining and smelting copper ores. While the property was still operating at the time of their departure, the management had been assumed by committees of workmen, in accordance with their ideas of freedom. Messrs. Carlyle and Hull expect to make Salt Lake City their headquarters for some time.

MR. A. E. DRUCKER is in Baltimore supervising the construction and starting of a concentrator mill.

MR. ALFRED D. FLINN, deputy engineer of the Board of Water Supply, New York City, has been elected secretary of the Engineering Council, secretary of the Engineering Foundation, and secretary of the United Engineering Society. The Engineering Council was formed early in the fall of 1917, and its organization was described in our issue of Sept. 15, 1917. The United Engineering Society is the governing board of the Engineering Societies Building into which the Civil Engineers recently moved, and the Engineering Foundation is the founder organization of the societies which originally combined into the one organization. Thus all these activities will center in one man.

MR. L. F. S. HOLLAND, lately field engineer for the Consolidated Arizona Smelting Co., Humboldt, has been appointed consulting engineer to the Arizona Mines & Reduction Co., Wickenburg, Arizona.

MR. D. C. JACKLING, of San Francisco, has been placed in charge of building the Government's explosive plants. He will act under authority of the Secretary of War, by whom he was appointed. There is contemplated the expenditure of more than \$90,000,000 in the erection of explosive plants for the Government, in order to supplement the present output of private manufacturers which it is calculated will not be sufficient to meet the Government's future needs.

MR. E. F. LAKE, metallurgical engineer, formerly located in Detroit, Mich., has taken the position of assistant superintendent of the Rich Tool Co. The company is manufacturing one-piece valves from high-speed steel for airplane and automobile engines. It is also making valves from a

high chromium steel similar to the stainless steel recently placed on the market.

MR. R. A. LEAHY, formerly on the research staff of the Anaconda Copper Mining Co., has joined the Royal Flying Corps, and is now at Toronto, Ontario, Canada.

DR. GILBERT N. LEWIS, of the University of California, has recently received a commission as major in the gas service. He will go abroad.

THE HON. SIR CHARLES PARSONS, member of the Council of the Institute of Metals (London), is to give the eighth annual May lecture before the Institute of Metals next spring. The lecturer will deal with the subject of the formation of artificial diamonds, which he has been experimenting upon for over thirty years.

MR. ROBERT K. TOMLIN, JR., managing editor of *Engineering News-Record*, sailed recently for France to serve *Engineering News-Record* and the other McGraw-Hill engineering publications as special correspondent at the front.

Prof. WM. H. WALKER, head of the chemical engineering department of Massachusetts Institute of Technology has been commissioned lieutenant-colonel in the Chemical Corps, U. S. A., a newly created branch of the war department. He will have charge of co-ordinating the chemical activity in this country while Dr. Raymond F. Bacon, of Mellon Institute, Pittsburgh, will be engaged in the same capacity in France.

Obituary

DR. HUGO SCHWEITZER, the well known chemist and dye expert, passed away Dec. 23, at his home 410 Riverside Drive, New York City. He was head of the Synthetic Patents Co., 117 Hudson Street, New York City, and had a long experience in dyestuffs and organic chemistry. He was born in Germany in 1861 and received his degree at the University of Freiburg. He was successively chemist for the Badische Anilin and Soda Fabrik, Ludwigshafen, and the Farbenfabriken, formerly Fr. Bayer Co., Elberfeld. After he came to this country he became an American citizen and was past secretary of the New York Section of the Society of Chemical Industry and ex-president of the Chemists' Club.

Book Reviews

PRACTICAL PYROMETRY. By E. S. Ferry, G. A. Shook and J. R. Collins. Duodecima (14 x 20 cm.), 147 pages, 73 illustrations. Price, \$1.50. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd.

An elaboration of notes compiled for a student laboratory course in Purdue University. After a short introductory chapter on temperature scales, the other four chapters deal with resistance, thermoelectric, radiation and optical pyrometry respectively. These are well presented, with many good experiments to teach the basic principles on which they act. Other forms of pyrometry than these four are practical, however, and are not considered. The book is to this extent defective. The English is poor at places, and scientific terms carelessly or inaccurately used at times. We cannot agree with the statement that iron, steel and nickel become brittle at about 700 deg. C. (p. 27). The book is pretty good, with some weak features, like those noted.

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METALLURGICAL CALCULATIONS. Part I: Chemical and Thermal Principles. By J. W. Richards. Fourth Edition, revised and enlarged. Octavo, 238 pages. Price, \$2.00. New York: McGraw-Hill Book Company. London: Hill Publishing Co., Ltd.

Since the first edition of this work was published, in 1906, it has become so widely used and known that further cataloging of its contents is unnecessary excepting a notation of the improvements in this last edition. The valuable thermo-

chemical tables have been brought up to date, and arranged in a better form; the tables of thermophysics of the elements have been greatly extended, to include heats of fusion and vaporization and vapor tensions of the elements; the thermophysics of chemical compounds have been amplified; the table of thermal emissivity has been lengthened by recently determined data. This fourth edition should therefore be much more valuable to the metallurgist and engineer than the preceding editions. By an unfortunate error (page 100), the total heat in mercury at its boiling point is given as 117 instead of 11.7, which changes the heat in the vapor at the boiling point to 79.5 and at the critical point to 100.

The publishers inform us that they contemplate issuing a one-volume edition of all three parts of Dr. Richards' work. It may not be generally known that these calculations have been translated into Russian, Italian and German, and that translations into French and Spanish were begun, but have been interrupted by the war. This is an enviable record of the general appreciation of these books by technologists in all parts of the world.

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EVERYMAN'S CHEMISTRY. By *Ellwood Hendrick*. Octavo, 374 pages. Price, \$2 net. New York: Harper and Brothers.

This is a book in which the author sits down with you and converses delightfully on the "ways of stuff," in an effort to convey to the average man a sense of the importance of chemistry in modern life. If he catches your interest lagging or your eye wandering, he promptly recovers your attention by opening a new view of the subject. Those who have thought of chemistry as though it were spelled "chemystery" will find here an easy comprehension of the elements of the subject that will lead them on to deeper study. Being a man of imagination, the author resorts to many forms of imagery in order to convey his subject clearly and interestingly to the reader. He frequently resorts to analogy between the "ways of stuff" and the characteristics of people to show why materials act as they do. Thus, among the "red-headed halogens" we find fluorine to be a "young devil" and iodine an "old man with a past." Allotropy is explained as a sort of "Dr. Jekyll and Mr. Hyde" state of matter. The stories of the elements and their compounds are enlivened by up-to-date examples of chemical application in the arts. In this way the author brings in the Cottrell process, permutit, fixation of nitrogen, and the simple metallurgy and uses of the metals. War time is reflected in the mention of war uses for chemicals, notably explosives. All the romantic interest attaching to the chemistry of carbon compounds is brought before the reader in as much detail as the scope of the book will permit. The wide distribution of the book will make for an enlightened public intelligence on the great chemical industry which is bound to grow in importance in this country.

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LABORATORY GUIDE OF INDUSTRIAL CHEMISTRY. By *Allen Rogers*. 212 pages, illustrated. Price, \$2.00. New York: D. Van Nostrand Co.

A laboratory manual of Industrial Chemistry prefaced by a brief description of the more common forms of industrial chemical apparatus. Then follows a series of experiments in inorganic preparations, the raw materials being used in about one kilo lots. Typical preparations described are magnesium sulphate, potassium permanganate, sodium thiosulphate, sulphur monochloride, etc. A chapter is devoted to organic preparations corresponding to those usually given in a beginning university course in this subject.

The main part of the manual is devoted to well-chosen experiments in the dyeing of textile fibers, pigments and lakes, driers, varnishes, paints and stains, soaps and allied products, leather manufacture and wood fiber and paper. In each case the detailed experiments are preceded by a concise statement of the main principles involved. The experiments are representative and reflect factory operations, and should be of great value to the student, especially when they are carried out under the foremanship system as at Pratt Institute, where "groups of students are assigned to work in model plants, one member of each group acting as foreman.

The foreman is held responsible for the quality as well as the quantity of the output of his plant, must see that the machinery is left in perfect condition, and that the factory is kept clean." Few schools could carry this method out, which ought to give good results, but the text should be a workable one, even with less equipment than the foreman method involves.

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A PRACTICE BOOK IN ELEMENTARY METALLURGY. By *E. E. Thum, E. M.* Octavo (15 x 23 cm.), 321 pages, 57 illustrations. Price, \$2.75. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd.

The author was assistant professor of metallurgy at the University of Cincinnati, and prepared this book for the use of his students, who, according to the system there in vogue, come to the university in alternate two-week periods, spending the other periods in shops or works. The limited time allowed for lectures gave little opportunity for discussing with the students the principles underlying the experiments, so it was decided to write a laboratory manual for them and print the explanations therein. The subjects covered by the experiments are well chosen, and students carrying them through and studying the text cannot fail to learn some good metallurgy. On the other hand, the details are so closely connected with the local conditions and limitations under which the author labored that the general usefulness of the book is greatly impaired thereby. It may be a very useful handbook at the University of Cincinnati, and it might be of very little use in some other institutions differently situated, with different equipment, and with students working on a different plan of instruction. It is, however, full of good suggestions for anyone planning metallurgical laboratory work.

The Chemical Market in the United States in 1917

Coal Tar Products

During the past year additional strides were made in the production of coal tars and intermediates; in fact, this branch of the chemical industry continued to hold out the most glowing prospects in the way of a quick return on the money invested, which, of course, is always the primary consideration in the establishment of a new industry, inasmuch as it is then possible to secure sufficient financial backing to carry forward the perfection and completion of experiments with the proper degree of assurance. While the years 1915 and 1916 saw considerable in the way of improvements, not only in production, but also in the quality of the products, the year just passed has eclipsed the records of these years to such an extent that they seem to be mere memories, as we review the happenings in 1917. At the close of 1916 practically all the intermediates were being produced, with the exception of a few, which were more difficult to produce and bring to a state of perfection. But during 1917 ideas were developed in a slow, painstaking manner and concentration was more generally adhered to in an endeavor to overcome the temerity of consumers of American products, who had been disappointed when they found that these products could not be used to the same advantage as the foreign products to which they had been accustomed. With renewed application some of the larger producers succeeded in overcoming the prejudice thus engendered by the production and perfection of high-grade products, with the result that as the year ends there is practically nothing that Germany produced that we have not been able to master.

For a time the pioneers in the field of production in specialties waxed fat on the new industry. But the way of the world was not different in this case than others, and as soon as it became apparent that this new field offered such wonderful opportunities, many new companies entered into the line, with the result that at the end of the year only a few of these concerns were able to weather the sea of competition, with its slashes in prices and general undermining of the industry, and the year ends with only the stronger factors surviving and prices on a lower parity. The tendency in general is rather to build up a regular trade by the pro-

duction of a standard product at a good though not unreasonably large profit. With this object in view, many firms have established for themselves a name that is synonymous with quality and their success is encouraging.

As the year draws to a close several producers of the intermediates have curtailed and some have closed down owing to governmental seizure of toluol and phenol, except when used in the fulfillment of requirements for the government. But it is the general impression that the authorities at Washington will shortly arrange matters so that the industry will not be destroyed. Release of material to consumers is expected shortly, through the medium of committees.

The industry on the whole has not been affected by the entry of this country into the war.

COAL TAR CRUDES

Production figures of benzol are not available, but greater quantities were produced this year than last year, and authorities believe that the total will be several million gallons over last year's estimated total of 30,000,000 gal. There were 70 concerns with benzol recovery apparatus as against 61 in 1916. While the output in 1916 was fairly well absorbed, the quantities produced in 1917 were greatly in excess of the demand, as there was considerable falling off in export requirements, with the result that prices have been tumbling for the past few months and apparently have not yet reached the bottom. Benzol on spot can be done now at 36c. to 40c., according to quantity and buyer and seller, as against 75c. to 60c. in 1916, and 77c. to 80c. in 1915. Contract business over 1918 is being done at 36c. to 42c. for the pure material. The 90 per cent grade is not produced in such great quantities and a higher price obtains for this material than for the pure, but some rubber manufacturers apparently prefer this grade.

Toluol.—During the year prices did not vary greatly from those prevailing at the close of 1916. For the most part \$1.50 to \$2.00 covered the range. However, in November the government requisitioned the entire production for use in the manufacturing of explosives, and such quantities as were in dealers' hands have since sold at fancy figures. As high as \$3.50 a gallon has been paid for small quantities. Producers of intermediates to be used as dye bases, or in other necessities, have been favored with releases of moderate amounts, but they are for the most part operating on a hand-to-mouth basis. It is probable, however, that a committee will be appointed to handle in a business-like way the matter of releases. The 1917 production was much greater than the 8,000,000 gal. produced in 1916, but accurate production figures are not available.

Xylol.—The production was greater during the past year, with large surplus quantities backing up on the market, the price for the different grades ranging from 30c. to 50c., according to quality and quantity, as against 50c. to \$1.20 last year.

Naphthalene.—The production has been materially augmented but with only comparatively small quantities being imported from England because of heavy duties, domestic manufacturers had a better opportunity to dictate prices, but the variation in price during the whole year was not great. From 8c. to 9½c. covers the range, and at the close of the year sales were consummated as high as 9½c. for prime white flakes. Off color material sold at slightly less. The ball material was selling at 10c. to 11c. The total production in the United States was estimated at approximately 25,000 tons, as against 12,500 tons in 1916.

Phenol.—Phenol has probably been the feature of the list with prices fluctuating from day to day, and at times from hour to hour. There has been a steady demand, both for export and domestic consumption, in the making of intermediates for dyes and explosives. The production has materially increased and at times this has had more or less bearing upon prices. At the beginning of the year prices held at 53c. to 55c. and from time to time prices varied over a wide range, until the low level of 40c. was reached. Eventually, however, as surplus quantities were absorbed, a firmer undertone prevailed, until at the end of the year prices had gradually climbed back to their former position and 50c. to 53c. was the prevailing figure. About Dec. 15, however, the government began commandeering this product

for use in the manufacture of explosives, and it was understood that producers were to receive 38c. a pound. In general offerings to the regular trade were restricted until such time as governmental requirements were filled. The production during 1917 was estimated at 25,000 tons as against 12,500 tons in 1916.

INTERMEDIATES

Great strides were made in the production of the intermediates and some of the problems that had not been solved in 1916 were brought to a successful conclusion in 1917, and practically every item of importance on the list was being produced. Aniline oil, following in sympathy with benzol, was produced on a lavish scale, and for a time the large quantities were being offered at a premium, but the producers finally got matters in hand to a certain extent, and from 25½c. to 26c. was the prevailing price, figuring in transactions of moment. Producers, while making large contracts over next year at these figures, were endeavoring to secure 28c., with a limited degree of success. The quality of the oil produced continued high and met with favor in the trade. While production was considerably greater than in 1916 authorities were unable to give exact figures.

Aniline Salts.—While the production followed closely that of aniline oil, the salts were more readily absorbed and prices did not reach as low levels as the former. Several producers dropped out, the field therefore being easier to check up. At the close of the year second hands were offering at 28c. and 29c., with producers asking 32c. to 34c.

Nitro Benzol.—The production was heavy for a time, and the market was flooded with supplies, but several producers discontinued this line, and the position was slightly improved, although there is still a plenitude of supplies. At present the market is quiet, with 17c. to 19c. quoted, and contracts involving large quantities have been made as low as 16c.

Toluidine.—This item was being produced by about a half dozen concerns during a part of the year; at the close there were but two factors in the field who were producing both, the *ortho* and *para*. The toluol situation has not yet affected same, and the *para* grade was bringing \$2.00 to \$2.25, with the *ortho* at 85c. to 90c.

Picric Acid.—The production narrowed down to a very few producers, who, for the most part, were catering almost exclusively to the Government, and but very little was procurable in the open market.

Tri Nitro Toluol.—Governmental needs have resulted in the elimination from the open market of this product.

Para Nitro Toluol.—This product was rather extensively produced, being in goodly demand with dye producers. However, the quality was not always up to specifications, with the result that those who had not been able to produce a quality product rapidly dropped out, until at present there are only two factors in the field, with \$1.50 to \$1.60 as the prevailing price.

Ortho Nitro Toluol.—The conditions were much the same as in para nitro toluol, with only a few factors holding sway, with 75c. quoted as the inside figure.

Metanitroparatoluidine.—This material was in goodly demand, with production restricted to a few quarters and material scarce, with \$5.50 quoted.

Paranitraniline.—While during the early part of the year many producers were behind in the fulfillment of contracts, the increased demand from dye producers, however, was instrumental in increasing the production, and for the past few months it has been freely offered at \$1.10 to \$1.15 as against \$1.60 to \$1.70 last year.

Alpha Naphthylamine.—This product is closely identified with dye production, and has been produced in large quantities. Prices have declined as a result, and it was possible to do 58c. to 65c. as against \$1.25 a year ago.

Dimethyl Aniline.—Of considerable importance in the production of some dyes, large quantities were manufactured and prices were not subject to much change; from 55c. to 60c. prevailed.

Diphenyl Amine.—Has been in fair demand with the producer of dyes, but of late munitions requirements have been heavy and there is but little procurable in the open market. It sold at times from 85c. to \$1.00.

Para Phenylene Diamine.—The production for the most part has been confined to one quarter, with a good demand. Prices have been well maintained at \$3.50 to \$4.00.

Metaphenylene Diamine.—Only two or three producers are in this field, and there is a goodly demand, with a scarcity at present, and \$1.75 to \$2.00 is quoted.

Para Nitro Phenol.—This material is used extensively in developing by photographers. Goodly quantities were produced, with the demand fair and prices at \$1.50 for the powdered crude material and \$2.00 for the needle crystals.

Ortho Nitro Phenol.—Was produced in goodly quantities by several concerns for a time, but most of these dropped out. The demand from fur dyers is heavy, with supplies light and prices at \$1.40 to \$1.50.

Beta Naphthol.—An abundance of this material has been produced; so great were the quantities on the market that prices were forced down from \$2.00 to 65c. for the technical grade and from \$2.75 to 85c. for the sublimed material.

Para Amido Phenol.—The production has been heavy during the past few months, and competition is keen, but the cost of raw materials tends to keep prices at a fairly high level and from \$4 to \$5.50 is quoted for both the hydrochloride and base. Ordinarily there is a difference in price between the two. One producer has recently placed upon the market a needle crystal which is expected to attract some attention.

H Acid.—During the year there were as many as 8 to 10 engaged in the production of this acid with a total output estimated at from 125 to 150 tons monthly, but as the demand eased off, several dropped out and at present there are about six who are producing quantities of moment. Prices vary with \$2.15 as the inside figure for the paste, from \$3.00 to \$3.50 for the 100 per cent and \$2.50 for 97 per cent.

Gamma Acid was produced in a limited way by one or two concerns, but inquiries in the market for large quantities of spot material failed to locate same, and orders for fairly large quantities were unfilled.

Neville & Winters Acid is being produced in goodly quantities, but the demand of late has fallen off somewhat, and \$2.00 is quoted for 100 per cent material in ton lots.

Benzoate of Soda.—This item has had a very interesting career since the commencement of the war in 1914. At that time we were almost wholly dependent upon Europe for our supplies. In August, 1914, it was selling at 23½c. a pound. Prices increased by leaps and bounds until in December, 1916, the soda sold for \$8.50 a pound, and the acid at \$10.00 to \$12.00 a pound. A number of large producers entered the field, a price-cutting campaign was launched, and the weaker factions were eliminated. During the past few months inability to secure toluol has curtailed production and prices are once more in the ascendant with \$3.00 to \$3.50 as the prevailing prices respectively for the soda and the acid.

Salicylates were produced on rather a heavy scale, but prices are somewhat higher than they were a year ago, although the demand at present is not pressing for the sodium which is selling at \$1.30 to \$1.35. Salicylic acid, however, has met with a goodly demand, and there are large quantities being produced, which are selling at \$1.10 to \$1.30 for spot or prompt material and 85c. to \$1.00 on contract for the U. S. P. grade. The technical grade is not in great demand, with price quotations at 75c. to \$1.00 for spot material.

Aniline Dyes

Great progress was made in finished dye production in 1917, and the relations between producer and consumer are very satisfactory. The improvement in quality and variety has been very pronounced. In 1915 the total domestic production of aniline colors amounted to \$2,470,096. The exports for the fiscal year ending June 30, 1917, were valued at \$11,710,887 as against \$5,102,002 for the same period in 1916. These figures include both aniline and natural dyes, however. Anilines are more than 50 per cent of the totals.

During July, August and September British India purchased dyes from us to the value of \$84,967, Canada \$161,581, Spain bought \$105,505 worth of dyestuffs during this time and France bought to the extent of \$86,379, Japan \$80,073, Mexico purchased to the value of \$75,353 and Italy

\$67,484. At the present time American color producers are well armed to compete with German dyestuff manufacturers in regard to most colors. Of late the markets on benzol, phenol and toluol have been tight, affecting domestic color producers. A number of small firms formerly making malachite green crystals have gone out of business for the want of toluol. It is noted that many firms previously engaged in other lines of business have entered the dyestuff industry and are now listed among American color producers. A cotton concern in the South, for years engaged in the cotton business, is now producing sulphur colors, and an ink firm in California who, for many years, was solely engaged in the manufacture of various inks, has entered the dye business and is now producing a lithol red. Another ink firm in Cincinnati has invested large sums of money in a plant to manufacture colors, and is now producing a metanil yellow. This same firm is making paranitraniline, from which para red is produced. To-day we find large and small manufacturers of colors from all over the United States busily engaged in experimental work. The fuchsine produced in this country rivals the German standard "Diamond" brand goods in both strength and shade. Primuline is being made here in fairly large quantities. Exporting to South China and Japan is demanding the attention of American color manufacturers as well as exporters. Pre-war figures show that Hong Kong used annually around \$1,000,000 worth of dyes. Shanghai is another dye center. This section has been accustomed to using natural dyes and vegetable indigo, and the uses of aniline colors are not thoroughly understood as yet. According to reports, Germany has established centers in the leading dye districts of Japan and China for the instruction of the local dyers. It is generally thought that in order for the United States to establish a firm trade in these countries the business will have to be worked out along these lines. Some Japanese dyes are offered in the United States, however. They do not meet with the approval of important mills. Seemingly high standards have not been established in Japan as yet. The principal color made in Japan is yellow. The South American trade calls for the cheaper grades of anilines. The Spanish export trade is demanding considerable attention and orders for \$150,000 worth of dyestuffs at one time are not infrequent. Spain buys some of the more difficult colors, including metanil yellow, patent blue, azo yellow, malachite green, fuchsine. All concerned are looking forward to a prosperous year in 1918, and it is expected that many of the complicated German colors will be produced during this period. At this writing there are 136 actual producers of anilines in America. The State of New Jersey leads with 47 color manufacturing plants, New York has 30 representative plants, Massachusetts is third in line with 11 plants, the Keystone State is represented by 7 plants. Other States are named in order of their importance as follows: Connecticut, Michigan, Ohio, Rhode Island, Illinois, North Carolina, Missouri, Maryland, Minnesota, Washington, Florida.

Heavy Chemicals

The production of practically every chemical under this classification during the past year was by far the heaviest in the history of the industry, and while there was a great element of speculation still noted in a number of the items, the market presented many aspects of stability. In certain items prices receded to levels that prevailed prior to the European war. At the moment of writing the entry of the United States into the conflict has had surprisingly little effect on conditions generally. However, it must be realized that the organization of the innumerable purchasing divisions in the national capital has taken a great deal of time and it was only toward the close of the year that these official organizations began to show their authority. There seems to be but little doubt current that a large number of the industries will eventually come under direct governmental control with prices fixed.

Potassium Salts.—A comparatively tame year was again reported in these products. German muriate of potash sold throughout the twelve months at about the unchanged level of \$350. Moderately large quantities of Japanese muriate reached this market from time to time, and as is usual with a new product, consumers were inclined to discount

its value. The first shipments did contain a rather heavy sulphate content, and it is now stated that this and other impurities have generally been removed, so much so that the Japanese product generally commands a price close to that secured for the German material. The production from domestic sources continued in a larger way. As heretofore the Nebraska lakes furnished the bulk of the production, but it is not thought likely that the present production in this country from lake brines, cement and other sources totals as yet 15 per cent of the normal consumption before the war.

Ammonium Salts.—During the year the usual development of the trade that possibly stands out most is that fact that there were unusually large export shipments of sulphate of ammonia to England—heretofore the principal producer—and to countries that England heretofore shipped exclusively. As a matter of fact, sulphate of ammonia passed about out of the category of a domestic fertilizer material. On Oct. 1 an embargo on exports stopped this trade, but there was such little material available that the market was not noticeably affected; as a matter of fact, the high price of 7.30 double bags f.a.s. was quoted toward the close. The quotation at the beginning of the year was 4.50. **Ammonium nitrate** was a product that brought with it many disappointments toward the close of the year. After an unusually heavy export inquiry the demand suddenly ceased and prices dropped off so that to-day there is much material on the market that cannot be moved at even 19c. At times during the year the price rose to 21c. The manufacturer of this explosive has been up against a most serious problem in the matter of raw material. Upon the entering of the United States into the war the demand for anhydrous ammonia for refrigeration purposes for the enormous foodstuff supplies for the armies both at home and abroad brought the attention of the authorities to this situation. Considerable speculation had already been rife as a consequence of the heavy demand from the Allies. Toward the close of the year the government has consulted with the leading producers, and it is generally thought that an understanding has been reached whereby the production of ammonia will be principally of the liquor to the exclusion of sulphate and aqua ammonia. The nitrate manufacturers have been assured of their supplies. The government's price is 14c. **Muriate of Ammonia** (sal ammoniac) has been in increased demand and from a normal price of 5½c. for the gray material it is difficult to purchase the product now at 15c.

Nitrate of Soda.—The imports for the fiscal year ending June totaled the record amount of 1,261,658 tons, valued at \$44,231,240. This compares with 1,071,728 tons valued at \$32,129,397 during the corresponding period of 1916. Notwithstanding the enormous tonnage brought into this country prices reached new record levels, and some lots at one time changed hands at 5.25, although 5.10 was about the high level for important business. Toward the end of the year, however, there was a large amount of resale material offered, and seemingly the tonnage purchased early in the year had not been absorbed. These sales forced the market down to approximately 4.60. Of the manufactured **sodium salts** the sulphites came in for much attention, particularly **sodium sulphite** for moving picture developing. **Chlorate of soda** sold at 20c. for contract, but the production held well and generally firms not under contract at this figure had to purchase in the market at a higher level. **Acetate of soda** was another item under this classification that attracted much buying attention. At the close of the year the market was absolutely bare, and a nominal quotation of 17½ to 18c. prevailed, with sellers not inclined to quote for next year. **Nitrite of soda**, as a result of several new manufacturing sources entering the field, including an air nitrogen concern on the Coast and one of the largest explosives manufacturers, has receded from its high level of 58c. reached at one time during the year to the present level of 30c. at which contracts for 1918 are being offered. Owing to the restricted production of **silicate of soda** the product was generally at a premium throughout the twelve months. The product is one that has attracted but little additional capital, and so far the production, particularly of the 60 deg. material, has not increased sufficiently to take care of the consumption. **Sodium sulphide**, which is a by-product with the barium salts industry, has been scarce, and to-day

commands a price about double that prior to the war.

Sulphuric Acid.—The feature of this all-important branch of the chemical industry during the past year has been the great scarcity of Spanish pyrites as a result of the submarine scare and the abnormally high freight rates, with the result that a large number of the acid plants heretofore burning pyrites were as a result of this situation compelled to install apparatus for the burning of brimstone. This, of course, meant radical change in the operation of the plant, requiring in many instances a new study of manufacturing problems. However, the crisis has been well met and to-day the production of sulphuric acid is by far the heaviest that has ever been recorded in the history of the American chemical industry. The entry of the American government into the war naturally would eventually make its influence felt in the chemical industry, and sulphuric acid was the product that was to feel this influence first. Until we were actually at war the markets presented rather weak aspect. Acid was to be obtained at prices representing not a great enhancement over those before the European conflict. At the moment of writing the situation has become so uncertain that many factors are predicting \$80 acid by the spring and \$200 oleum. This, of course, refers to acid for the outside market. It is reported, but not so far definitely confirmed, that for government account manufacturers will be compelled to furnish 66 deg. brimstone acid at \$28 works, with a probability that the brimstone will be furnished by the government at a fixed price. It is understood that already some of the Southern fertilizer works have been furnished brimstone for acid manufacture at \$22.00. Acid for the ordinary consumer at the close of the year was generally held at \$38.00 to \$40.00 for the 66-deg. brimstone, buyers' tanks, as sellers' tanks were not generally available. The government will undoubtedly sooner or later assume control of the industry, and it is reported that already consumers have been classified in four divisions, and will receive acid according to their relative classification.

Nitric Acid.—At the time we write the nitric situation has not shown particularly noticeable results of the country's entry into the war. Undoubtedly it will but with the nitrate of soda market easier and consumers not very much interested sales are not urgent. At one time during the year prices ranged from 14 to 15c. per unit, but toward the end of December 42-deg. material was available from 8c. to 8½c. per pound from various manufacturers.

Muriatic Acid.—The year was a tame one for this product. The movement was generally about what might be expected in normal times, but toward the close of the year the material was rather scarce and prices gave promise of reaching a higher level. However, values were not subject to much fluctuation during the twelve months. The scarcity of carboys tended to restrict the movement somewhat.

Acetic Acid.—The first half of the year witnessed an extremely active and heavy demand for practically all grades of acetic acid, particularly glacial. The last half of the year was featured by an extremely quiet and dull market, with the product mostly offered by second hands and probably resale material. Glacial acid sold well above the 30c. level throughout the interval, reached 36c. or 37c., and at the close was available at 33c. to 34c. Fifty-six per cent material closed at 5½c. from second hands, and a lot of 30 long tons of 80 per cent material changed hands toward the end of December at 11½c. As there is now an embargo on exports of acetic acid and acetates and the government has taken over the wood distillation industry, interesting developments are to occur.

Lactic Acid.—An increased production and rather quiet consuming demand throughout the year brought with it but little change for this commodity. The year closed a fraction above the prices ending 1916, with market conditions quiet.

Phosphoric Acid.—The production has seemingly set pace with the demand, and at the close of the year the 47-48 per cent acid was quoted at 7½c. as against practically double this price at the close of 1916.

Oxalic Acid.—While several new productions were inaugurated or planned, as yet none of them have seriously affected conditions here and the original American manufacturers continue to dominate the field. The price now current is 45 to 46c. as against 43 to 45c. at the close of

1916. Dutch oxalic acid has practically disappeared from the market as a result of freight difficulties.

Cyanides.—During 1916 the soda reached the high level of \$1.75 to \$1.80. Since then there has been a gradual recession and to-day second hands are offering the material at prices ranging from 44c. to 46c. as to point of shipment. The new plant of the only American producer in Vermont will increase the output here, and this of course does not tend to strengthen the market. The producers as heretofore sell only to the regular trade on contract and trading in outside lots is perforce in second hands.

Bichromates.—The production of both soda and potash continues well under the control of the leading producer, and so far there has not been a production sufficiently important to interfere with the operations of this concern which establishes the market, and prices generally follow their views. The 1917 contract price, it will be recalled, was 24c., but the outside market was generally below this during the year, although on some occasions it was slightly higher. The 1917 price is 16½c., but owing to under freight conditions from New Caledonia and the possibility of the government commandeering the chrome supplies, contracts are reported to contain a clause permitting the producer to advance prices under certain conditions incidental to these conditions. The year closes with second hands quoting jobbing lots at 17c. There are about eight plants with equipment for bichromate of soda or its equivalent production, but the production is principally confined to three producers. A new small producer plans a production for 1918. *Bichromate of potash* had a very uninteresting year. One of the three producers ceased manufacturing.

Copper Sulphate.—The export of this product is of course the mainstay of the trade and up to the end of September it revealed an increase over 1916, but toward the end of the year there was a great amount of difficulty noted in exporting and prices receded to the lowest level that prevailed for a long time. At the beginning of the year the large 99 per cent crystals were selling at 13c. to 14c., but in December, 1917, second hands were quoting Nichols brand 99 per cent large crystals as low as 8½ per cent, although the producers' price was 9½c. There are some eight or ten firms now equipped to manufacture this product, but as heretofore the production is principally in the hands of the Nichols Copper Company and the American Smelting and Refining Company.

Caustic Soda.—A record of events in this market during the year would be merely the tabulation of price changes practically hourly. Such speculative activity has never been witnessed off Wall Street. The production was sold undoubtedly thirty or forty times over. Bills of lading have come to light with as many as twenty-four indorsements, and in some instances a purchaser of a car of caustic found his own indorsement on the bill two or three times. The extent of this trade may be readily grasped when it is considered that there are probably a hundred firms in the various cities working on a brokerage basis and dealing exclusively in caustic soda and soda ash. At the opening of the year the spot price for 76 per cent caustic soda in New York was 4½c. From this level there was a steady climb until in September a level of 10c. was reached. Effective Oct. 1, the government placed the product on the conservation list with the result that in one day there was a drop of 2c. The export trade has grown beyond the dreams of the most optimistic member of the industry. There are no statistics available yet concerning the total of this trade, but from the port of New York alone the shipments totaled four, five and six thousand tons monthly. The works have generally been sold out during the year. The market has been exclusively in the hands of traders. When the drop occurred on Oct. 1 the market continued to weaken until at the close of the year spot cars were selling at 6½c., New York, with contracts over 1918 from reliable dealers generally held at 6½c. works or New York. The production at the moment is in the hands of some twenty-six or twenty-eight firms. Just how large the output is no one seems to know, but it is estimated to be from 750,000 to 1,000,000 tons.

Soda Ash.—The market has been more or less a repetition of caustic soda but prices were not subject to such wild flurries. There was much speculation, but the product was

not so closely controlled. The year opened with bags quoted at 2.95c., and from this there was a steady but slow climb to the high point of 4.25, which was reached late in August. In October the market eased off somewhat in sympathy with caustic soda, and remained quiet until Dec. 1, when this product was also placed on the conservation list and exports prohibited. Exports have been reaching the unusual large amounts of five, six and seven thousand tons monthly from New York alone. As was the case with caustic soda, the market was in the hands of traders during the year and the works were not generally quoting to this class of trade. The year closed with spot bags quoted at 2.75 to 2.80, and contracts over 1918 at 2.95 to 3c. The production is estimated to be from 800,000 to 1,000,000 tons, and there are possibly thirty or forty producers.

Bleaching Powder.—The year has been a disappointing one for bleach producers. The installation of chlorine cells by the large consumers resulted in a neglected market and at one time during the year there were sales as low as 50c. per hundred pounds for 35-37 per cent material from warehouse New York. The production is placed at 150,000 tons. At the close of the year there was a firmer tone prevailing, and it was difficult to shade 2c. for fresh bleach and for 1918 shipments producers were quoting from 2½c. to 2¾c.

Chlorate of Potash.—It is generally presumed that the bulk of the contract requirements for 1917 were placed at figures ranging from 70c. to 75c. These buyers covered to their regret for the production seems to have exceeded the demand somewhat as the market from second hands never reached the contract price. There has been a gradual recession of values until toward the end of the year resales on these contracts were occurring as low as 35c. The 1918 price has not been announced as we write, but a statement has been made that 40c. is too high and the probabilities are that the figure will be below this level somewhat.

Current Market Reports

The Iron and Steel Market

Iron and steel prices as set by the War Industries Board and the American Iron and Steel Institute are likely to stand for some time. Conferences between the War Industries Board and the Federal Trade Commission and the iron and steel makers held during December have not indicated any strong desire upon the part of the Washington authorities to seek a downward revision of prices at this time, while the manufacturers have no hope of securing an upward revision. The Federal Trade Commission will probably push the Pomerene iron and steel price-fixing bill in Congress, with a proviso for the abrogation or suspension of some contracts. The trade commission has been rather puzzled at the wide diversity of costs shown in reports it has been receiving during the past six months, some being so high that a reduction in the set prices might operate to decrease production, and its only hope of paving the way for reductions appears to be in removing the effect of some high-priced contracts for raw materials. The Pomerene bill could hardly be passed before some time in February, and as it would merely empower the President to act it would be some time before real action would be taken, if indeed any at all were taken.

COMMERCIAL DEMAND VERY LIGHT

The ordinary commercial demand for iron and steel has become extremely light, while during the second half of December practically none of the demand that may exist has been expressed. Buyers have been busy with year-end adjustments, particularly complicated this year, and have had no interest in the market.

Buying by the government has continued heavy, if indeed it has not increased. It is estimated that about 1,200,000 tons of the 1,500,000 tons of shell steel required for delivery by the middle of June has now been placed. A very considerable tonnage has already been produced, as shown by the relatively free offerings of discard steel in the open market. This material will be rolled into billets down to 1½ in., and is offered at about \$2.50 below the set prices for soft steel billets. There is no precise information as to other steel re-

quirements of the government, but orders are being placed right along.

A comprehensive program involving cars and locomotives has been worked out at Washington against any decision that may be reached as to what is to be done with the railroads. This is a measure of preparedness, as, whether purchases of rolling stock to increase the capacity of the railroads are to be financed by the railroads or by the government, it will be necessary for the government's authority to be used to secure the earliest delivery of the raw materials for the rolling stock and its earliest manufacture.

TRAFFIC CONDITIONS

Traffic conditions as affecting the iron and steel industry have been worse in the second half of December than in the first half. In the Central West generally there has been a shortage of both coke and coal deliveries, worst along the lake front, with the Youngstown district coming next and the immediate Pittsburgh district faring relatively well, though suffering considerably. Production in the South has been fully up to normal, while conditions have been fair in the East. December production as a whole has been 5 to 10 per cent under the average of the first eleven months of the year, in which period there was production at 90 to 95 per cent of theoretical capacity.

The railroads were greatly affected by the cold wave of Dec. 8, which brought an average of zero weather to the Central West. Although the coldest weather lasted only about three days the railroads have not recovered. The difficulty is not so much congestion, as the operation of the pool of Eastern railroads had relieved conditions materially in that respect, as it is a shortage of motive power, evidently resulting from many locomotives having been incapacitated during the cold snap.

It is a small thing apparently that stands in the way of full production in the iron and steel industry, the movement of a little more coke and a little more coal, and it seems strange that the railroads have been unable to compass the extra movement. On the other hand, it is quite possible that if there were the extra production it would be impossible to move the additional finished product or serve the manufacturing consumers who would receive it. While there is a great deal of talk it is not made clear that the war activities or the ordinary peace activities of the people are really suffering from a shortage of steel.

PIG IRON

The demand for pig iron from iron foundries is light. While deliveries have been curtailed through irregular operation of merchant furnaces, the consumption of the iron foundries in general has undergone a great decrease. The steel works are all more or less short of pig iron and would buy in the open market, but there are practically no offerings. If the furnaces were in position to sell they would sell only at the set prices, based on \$33 at furnace. Some Alabama basic iron has been sold in the Pittsburgh district at this furnace price, involving a freight of \$4.55, when if the iron had been bought in the valleys the freight would have been only 95 cents.

FINISHED STEEL

With total output curtailed steel is being put into the forms most needed. Shell steel production is practically up to requirements, being chiefly a blooming-mill proposition. The plate mills are almost fully supplied, slabbing mills being operated full while all the blooming-mill slabs possible are being made. Sheet bars are being fully supplied to tin mills, which are operating at about 95 per cent, while supplies to sheet mills are correspondingly light, entailing an average operation of 50 to 60 per cent by the sheet mills. Production of welded-steel tubular goods is off somewhat, but shipments of oil-country goods in particular are well maintained. Wire production is somewhat curtailed.

Non-Ferrous Metal Market

Wednesday, Dec. 26.—The copper situation is somewhat easier, and signs are evident of larger supplies being available owing to reduced consumption and foreign shipments. Straits tin is very scarce. Lead is unchanged. Spelter has been dull and a little weaker.

Copper.—A meeting was held in Washington on Dec. 14 between the War Industries Board and representatives of the copper producers, to discuss the copper question for 1918 as regards requirements and prices. The producers, especially some of the smaller ones, said that present copper prices were not high enough to stimulate maximum production. Assurances were given that the producers could meet the country's needs. Lake and electrolytic remain at 23.50 cents with 24.67½ as the jobbers' price.

Tin.—Tin has been very scarce and at present there is no Straits tin on the market. Arrivals to Dec. 19 were only 1115 tons, and if any were for sale it probably would bring somewhere between 85 and 90 cents. The production of American electrolytic tin is said to be relieving the situation somewhat. Fortunately the demand does not appear to be extra heavy. All grades are very scarce.

Lead.—After a long conference on Dec. 17 between representatives of the principal lead producers of the country and the War Industries Board of the Council of National Defense, it was announced that no regulatory action affecting the industry would be advocated at this time. The question of fixing prices and providing for distribution of the lead output under Government control was discussed at length, and it is understood that the producers promised co-operation on the present basis, which was satisfactory to the board. The Trust price of 6.25 New York remains unchanged. Outsiders are asking 6.50 to 6.75.

Spelter.—This market has been dull, with prompt prime Western quoted at around 7.50 St. Louis, and brass special at 8.00 St. Louis.

Antimony.—There is no change in antimony. Prices remain at 15 cents for prompt delivery, with needle antimony at 9¼ to 9½. Antimony ore is quoted at \$1.75.

Tungsten.—The market has been firm in New York. Charles Hardy says that "on account of a very large foreign inquiry coming in at the same time as one of our largest users at home appeared into the market, the tungsten market has been exceedingly firm during the past week and most good grade ore in New York found ready buyers, even material on steamers shortly due was readily absorbed by the market. The tungsten price remained very steady at a slight advance and \$24.50 was paid for high-grade wolframite, with prices ranging lower for off-grade ore. Such scheelite as was offered was readily sold at \$26 per unit."

Molybdenum.—Demand for molybdenite is reported good and prices range from \$2.25 to \$2.30.

Chrome.—Very little high-grade chrome ore is offered, and the demand is good. The price remains at 90c. per unit, at California.

Quicksilver.—Very little spot material is available, as arrivals are very slow. California virgin is quoted at \$115, but higher prices have probably been paid.

OTHER METALS

Aluminium, lb.	36-38
Bismuth, lb.	3.50
Cadmium, lb.	1.50
Nickel, electrolytic, lb.	.55
Silver, oz.	.86½
Platinum, oz.	105.00
Palladium, oz.	130.00

Chemical Market

COAL TAR PRODUCTS.—Interest continues to center in this branch of the industry, although there has not been as much activity of late as heretofore. The government has added phenol to the conservation list, and it is unlikely that any material quantity will be released for ordinary commercial purposes. With both this product and toluol practically off the market the result is at least a temporary lull in trading. The situation in general is interesting and holds forth promise of future developments that may cause further decrease in supplies of essentials.

Benzol.—Continues weak. Large surplus stocks continue available at low figures and further concessions are believed possible.

Toluol.—The situation affecting this product is unchanged. There is practically none to be secured in the open market, the entire supply being in the hands of the government.

Naphthalene is firm and the market is quite bare of supplies, but a replenishment is expected shortly.

Phenol.—The government has taken over practically the whole production, and but little is available for ordinary trade requirements.

Benzoate of Soda is scarce and firm, with a fair demand, but only light stocks are held.

Monochlorobenzol.—The production is heavy and large surplus stocks are procurable at favorable prices.

Paranitraniline is being produced in large quantities, but there has been a better demand of late.

Metanitraniline continues to be offered in a liberal way, with the demand light.

Aniline Salt is slightly firmer, with second hands pretty well cleaned out and producers in command of the situation.

Aniline Oil spot stock continues to be offered in a liberal way at fair prices, but an advance is expected on business over next year.

Para Toluidine.—The market is firm, with production restricted on account of the toluol situation.

Ortho Toluidine.—While the demand is not heavy, production is somewhat restricted and the position is firm.

Tolidin continues to be in fair supply, but concessions are impossible because of the light supply of toluol.

Anthracene is in goodly demand, but there is a scarcity. A recent large sale appears to have cleaned out available supplies and higher prices are obtained.

Para Nitro Phenol is in goodly demand, with a fair production, and prices are unchanged.

Ortho Nitro Phenol.—At present the demand is greater than the supply, but new producers are entering the field. Prices are unchanged.

Salicylic Acid has been sold in large quantities of late, with prices unchanged because of large production.

Nitro Benzol has figured in goodly sales of late, but the production is heavy and prices are low.

Beta Naphthol has been in better demand of late, but large surplus quantities tend to keep prices down.

HEAVY CHEMICALS.—As is usual in December, there is a quiet and generally a weak market prevailing. This December has been no exception to this rule, and trading during the past two weeks has been of a very minor character, with prices generally inclined downward. Oddly a few items that have been quiet practically throughout the year end the year with a strong feeling prevailing.

Caustic Soda.—A much easier market has prevailed since our last report, and selling pressure has resulted in a spot price of about 6½c. ex-store. This new figure is probably accounted for by the fact that some second hands in fear of a lower 1918 market have liquidated their holdings. For 1918 deliveries most of the reliable factors quote 6.50 for two or three cars monthly from the works. Other traders are quoting lower but the usual uncertainty regarding deliveries makes a buyer hesitate somewhat before closing with these firms.

Soda Ash.—Real soda ash is not easily obtained for nearby positions. This condition of affairs is readily discovered if a buyer attempts to cover. The demand for spot and nearby, however, is fortunately for buyers not particularly heavy, and the market remains more or less inactive. Over 1918 there are sellers quoting 2.95 to 3c. for bags. Barrels are generally held at 3.15 works, but one contract from New York is available at a lower figure.

Copper Sulphate.—The market has been subject to a sharp drop. Nichols brand from second hands has been offered as low as 8½c., although the producers still quote 9½c. to 9½c. The lack of export trading is the cause of the present slump.

Cyanides.—There has been no change of special moment. Offers from second hands are reported from various points at prices ranging from 44c. to 45c. for the sodium. The so-called potassium has seemingly disappeared from the market. The new plant in Vermont will result in an increased 1918 output.

Bleaching Powder.—After practically twelve months of inactivity there are now more orders in the market than can seemingly be filled. Bleach for prompt shipment from works has been quite active, and buyers have found it difficult to cover generally. For 1918 business 2½c. is generally quoted as a minimum price but 2½c. is named as one contract figure.

Chlorate of Potash.—As we write the 1918 price has not

been publicly announced. There is much speculation as to the figure. It is generally assumed that it will be somewhat below 40c. The second hand market has been quiet and generally easy during the two weeks. Sales have occurred at 42c. and even 44c., but some firms anxious to dispose of contract material have offered several hundred kegs at even lower figures.

Acids.—As a result of the extensive government requirements and the fact that the acid production is now much oversold, the market for sulphuric acid has become almost nominal. There are offers reported from second hands, and these range from \$38 to \$40, buyers' tanks or drums returnable. **Oleum** has already reached the \$60 level and promises to pass that point soon. **Nitric Acid** has not been so firm. As yet there has been no pronounced demand. Nitrate of soda has been easier, but sulphuric is higher and an important demand will no doubt send prices higher. **Muriatic acid** has after a period of quietness become quite scarce and prices are somewhat firmer.

General Chemicals

WHOLESALE PRICES IN NEW YORK MARKET, DEC. 26, 1917

Acetic anhydride.....	lb.	1.80	—	1.90
Acetone, drums.....	lb.	.36	—	.37
Acid, acetic, 28 per cent.....	lb.	.05½	—	.06
Acetic, 56 per cent.....	lb.	.11½	—	.12½
Acetic, glacial, 99½ per cent, carboys.....	lb.	.35	—	.40
Boric, crystals.....	lb.	.12½	—	.14½
Citric, crystals.....	lb.	.75	—	.78
Hydrochloric, C.P.....	lb.	.08½	—	.08½
Hydrochloric, 20 deg.....	lb.	.02½	—	.02½
Hydrochloric, C.P., conc., 22 deg.....	lb.	.02½	—	.02½
Hydrofluoric, 30 per cent, in barrels.....	lb.	.06½	—	.06½
Lactic, 44 per cent.....	lb.	.15	—	.15½
Lactic, 22 per cent.....	lb.	.05½	—	.06½
Nitric, 36 deg.....	lb.	.08	—	.08½
Nitric, 42 deg.....	lb.	.08½	—	.09
Oxalic, crystals.....	lb.	.45	—	.46
Phosphoric, 47 per cent-50 per cent.....	lb.	.07½	—	—
Picric.....	lb.	Nominal	—	—
Pyrogallol, resublimed.....	lb.	3.15	—	3.25
Sulphuric, 60 deg.....	ton	—	—	—
Sulphuric, 66 deg.....	ton	60.00	—	80.00
Sulphuric, oleum (Fuming), tank cars.....	ton	1.30	—	1.35
Tannic, U. S. P., bulk.....	lb.	.76	—	.78
Tartaric, crystals.....	lb.	1.80	—	1.90
Tungstic, per lb. of W.....	lb.	5.05	—	5.25
Alcohol, sugar cane, 188 proof.....	gal.	1.35	—	1.40
Alcohol, wood, 95 per cent.....	gal.	.78	—	.80
Alcohol, denatured, 180 proof.....	gal.	.04½	—	.05
Alum, ammonia lump.....	lb.	.18½	—	.19
Alum, chrome ammonium.....	lb.	Nominal	—	—
Alum, chrome potassium.....	lb.	.12½	—	.13
Alum, chrome sodium.....	lb.	.08	—	.09
Alum, potash lump.....	lb.	.02½	—	.03½
Aluminium sulphate, technical.....	lb.	.03½	—	.04
Aluminium sulphate, iron free.....	lb.	.18	—	.19
Ammonia aqua, 26 deg. carboys.....	lb.	.10	—	.11
Ammonium carbonate.....	lb.	.19	—	.21
Ammonium nitrate.....	lb.	.07½	—	.07½
Ammonium sulphate domestic.....	lb.	5.25	—	5.40
Amyl acetate.....	gal.	.15	—	.16
Arsenic, white.....	lb.	.65	—	.70
Arsenic, red.....	lb.	80.00	—	90.00
Barium carbonate, 99 per cent.....	ton	65.00	—	67.00
Barium carbonate, 97-98 per cent.....	ton	70.00	—	90.00
Barium chloride.....	lb.	.03½	—	.04
Barium sulphate (Blanc Fixe, powder).....	lb.	.10½	—	.11
Barium nitrate.....	lb.	.32	—	.38
Barium peroxide, basis 70 per cent.....	lb.	.02	—	.02½
Bleaching powder, 35 per cent chlorine.....	lb.	.07½	—	.08½
Borax, crystals, sacks.....	lb.	Nominal	—	—
Bromine, crude.....	ton	.65	—	.70
Bromine, technical.....	lb.	.06	—	.06½
Calcium, acetate, crude.....	lb.	.08½	—	.09
Calcium, carbide.....	lb.	21.00	—	22.00
Calcium chloride, 70-75 per cent, fused, lump.....	ton	1.60	—	1.70
Calcium peroxide.....	lb.	.30	—	.31
Calcium phosphate.....	lb.	.07	—	.07½
Carbon bisulphide.....	lb.	.15	—	.16
Carbon tetrachloride, drums.....	lb.	.82½	—	.87
Caustic potash, 88-92 per cent.....	lb.	.06½	—	.07
Caustic soda, 76 per cent.....	lb.	.15	—	.18
Chlorine, liquid.....	lb.	1.40	—	1.50
Cobalt oxide.....	lb.	.01½	—	.01½
Copperas.....	lb.	.45	—	.78
Copper carbonate.....	lb.	.09	—	.09½
Copper cyanide.....	lb.	.55	—	.57
Copper sulphate, 99 per cent, large crystals.....	lb.	.03½	—	.04
Cream of tartar, crystals.....	lb.	.18	—	.20
Epsom salt, bags.....	lb.	.90	—	1.10
Formaldehyde, 40 per cent.....	lb.	.69	—	.70
Glauber's salt.....	100 lb.	4.25	—	4.35
Glycerine, bulk, C. P.....	lb.	.13	—	.15
Iodine, resublimed.....	lb.	.17	—	.17½
Iron oxide.....	lb.	.15	—	.18
Lead, acetate, white crystals.....	lb.	Nominal	—	—
Lead arsenate.....	lb.	.09½	—	.11½
Lead nitrate.....	lb.	1.50	—	2.00
Litharge, American.....	lb.	.48	—	.55
Lithium carbonate.....	lb.	.10	—	.10½
Manganese dioxide, U. S. P.....	lb.	.14	—	.15
Magnesium carbonate, tech.....	lb.	.11½	—	—
Nickel salt, single.....	lb.	1.70	—	—
Nickel salt, double.....	lb.	1.25	—	—
Phosphorus, red.....	lb.	.45	—	.46
Phosphorus, yellow.....	lb.	1.45	—	1.50
Potassium bichromate.....	lb.	—	—	—
Potassium bromide granular.....	lb.	—	—	—

Potassium carbonate calcined, 85-90 per cent.	lb.	.65	—	.70
Potassium chlorate, crystals	lb.	.42	—	.44
Potassium cyanide, 98-99 per cent.	lb.	Nominal		
Potassium iodide	lb.	3.75	—	3.80
Potassium muriate 80-85 p.c. basis of 80 p.c.	ton	350.00	—	—
Potassium nitrate	lb.	.28	—	.30
Potassium permanganate	lb.	4.10	—	4.25
Potassium prussiate, red.	lb.	2.40	—	2.50
Potassium prussiate, yellow	lb.	1.25	—	1.35
Potassium sulphate, 90-95 p.c. basis 90 p.c.	ton	Nominal		
Rochelle salts	lb.	.39	—	.39½
Silver cyanide, based on market price of silver.	oz.	.15	—	.16
Salammoniac, gray gran.	lb.	Nominal		
Salammoniac, white gran.	lb.	1.15	—	1.25
Salt soda	100 lb.	1.50	—	2.00
Salt cake	100 lb.	1.50	—	2.00
Silver cyanide	oz.	.52	—	.55
Soda ash, 58 per cent. light, flat	100 lb.	2.80	—	2.90
Soda ash, 58 per cent. dense, flat	100 lb.	4.00	—	4.05
Sodium acetate	lb.	Nominal		
Sodium benzoate	lb.	3.00	—	—
Sodium bicarbonate, domestic	lb.	.02½	—	.03
Sodium bicarbonate, English	lb.	—	—	—
Sodium bichromate	lb.	.17	—	.18
Sodium bisulphite, powd.	lb.	.06½	—	.06½
Sodium chlorate	lb.	.24½	—	.25
Sodium cyanide	lb.	.45	—	.46
Sodium fluoride, commercial	lb.	.18½	—	.19
Sodium hyposulphite	lb.	.02	—	.02½
Sodium molybdate, per lb. of Mo.	lb.	2.50	—	—
Sodium nitrate, 95%	100 lb.	4.65	—	4.75
Sodium nitrite	lb.	.30	—	.35
Sodium peroxide	lb.	.45	—	.48
Sodium phosphate	lb.	.04	—	.04½
Sodium prussiate, yellow	lb.	.35	—	.36
Sodium silicate, liquid	100 lb.	1.80	—	2.00
Sodium sulphide, 30 per cent crystals	lb.	.02½	—	.03
Sodium sulphide, 60 per cent, fused	lb.	.04½	—	.05
Sodium sulphite	lb.	.05	—	.06
Strontium nitrate	lb.	.25	—	.35
Sulphur chloride, drums	lb.	.06	—	.06½
Sulphur dioxide, liquid, in cylinders	lb.	.15	—	.40
Sulphur, flowers, sublimed	100 lb.	4.05	—	4.10
Sulphur, roll	100 lb.	3.70	—	3.85
Sulphur, crude	lb.	Nominal		
Tin bichloride, 50 deg.	lb.	.85	—	1.00
Tin oxide	lb.	.22	—	.25
Zinc carbonate	lb.	.10½	—	.11
Zinc chloride	lb.	Nominal		
Zinc cyanide	lb.	.17	—	.18
Zinc dust 350 mesh	lb.	.11½	—	.12
Zinc oxide, American process XX	lb.	.06	—	.07
Zinc sulphate	lb.	—	—	—

Coal Tar Products (Crude)

Benzol, pure, water white	gal.	.35	—	.40
Benz 1:50 per cent.	gal.	Nominal		
Toluol, pure water white	gal.	.35	—	.50
Xylol, pure, water white	gal.	.17	—	.22
Solvent naphtha, water white	gal.	.13	—	.16
Solvent naphtha, crude, heavy	gal.	.31	—	.35
Cresote oil, 25 per cent	gal.	.29	—	.30
Dip oil, 20 per cent.	gal.	8.00	—	20.00
Pitch, various grades	ton	1.05	—	1.10
Carbolic acid, crude, 95-97 per cent.	lb.	.60	—	.65
Carbolic acid, crude, 50 per cent.	lb.	.32	—	.35
Carbolic acid, crude, 25 per cent.	lb.	.19	—	.20
Cresol, U. S. P.	lb.	—	—	—

Intermediates, Etc.

Alpha naphthol, crude	lb.	1.10	—	—
Alpha naphthol, distilled	lb.	1.60	—	—
Alpha naphthylamine	lb.	.58	—	.60
Aniline oil, drums extra	lb.	.26	—	.27
Aniline salts	lb.	.32	—	.34
Anthracene, 80 per cent.	lb.	.50	—	.65
Benzaldehyde	lb.	4.00	—	4.50
Benzidine, base	lb.	1.80	—	1.85
Benzidine, sulphate	lb.	1.40	—	1.50
Benzoic acid	lb.	3.25	—	3.50
Benzyl chloride	lb.	2.50	—	2.75
Beta naphthol benzoate	lb.	7.00	—	8.00
Beta naphthol, sublimed	lb.	.85	—	.90
Beta naphthylamine com.	lb.	2.50	—	2.65
Dichlor benzol	lb.	.12	—	.18
Diethylaniline	lb.	3.75	—	4.25
Dinitro benzol	lb.	.34	—	.40
Dinitrochlorobenzol	lb.	.40	—	.42
Dinitronaphthalene	lb.	.55	—	.60
Dinitrotoluol	lb.	.55	—	.60
Dinitrophenol	lb.	.55	—	.57
Dimethylaniline	lb.	.85	—	1.00
Diphenylamine	lb.	3.00	—	3.50
H-acid	lb.	1.75	—	1.80
Metaphenylenediamine	lb.	.19	—	.22
Monochlorobenzol	lb.	.09½	—	.10
Naphthalene, flake	lb.	.10½	—	.10½
Naphthalene, balls	lb.	1.50	—	1.75
Naphthionic acid, crude	lb.	1.00	—	1.10
Naphthylamine-di-sulfonic acid	lb.	.45	—	.50
Nitro naphthalene	lb.	.50	—	.55
Nitro toluol	lb.	.90	—	1.00
Ortho-amidophenol	lb.	.75	—	1.00
Ortho-toluidine	lb.	4.00	—	5.50
Orth-nitro-toluol	lb.	4.50	—	5.50
Para-amidophenol, base	lb.	1.10	—	1.15
Para-amido-phenol, H. Ch.	lb.	1.50	—	1.60
Paranitraniline	lb.	3.50	—	4.00
Para-nitro-toluol	lb.	2.25	—	—
Paraphenylenediamine	lb.	6.30	—	6.40
Para toluidine	lb.	.52	—	.53
Phthalic acid anhydride	lb.	8.00	—	9.00
Phenol, U. S. P.	lb.	13.00	—	13.50
Resorcin, technical	lb.	1.20	—	1.30
Resorcin, pure	lb.	1.85	—	2.00
Salicylic acid	lb.	.32	—	.35
Sulphanilic acid	lb.	2.50	—	—
Tolidin	lb.	.75	—	.85
Tolidin-mixture	lb.	—	—	—

Petroleum Oils

Crude (at the Wells)

Pennsylvania	bbl.	3.75	—	—
Corning, Ohio	bbl.	2.80	—	—
Somerset, Ky.	bbl.	2.55	—	—
Wootter, Ohio	bbl.	2.38	—	—
Indiana	bbl.	1.98	—	—
Illinois	bbl.	2.12	—	—
Oklahoma and Kansas	bbl.	2.00	—	—
Cadizo, La., light	bbl.	2.00	—	—
Corsicana, Tex., light	bbl.	2.00	—	—
California	bbl.	.98	—	1.32
Gulf Coast	bbl.	1.00	—	—

Fuel Oil

New York	gal.	.11	—	—
Pittsburgh	gal.	.07½	—	.10
Oklahoma-Kans.	bbl.	1.50	—	2.35
Texas	bbl.	1.50	—	1.75
Los Angeles	bbl.	1.52	—	—
San Francisco	bbl.	1.45	—	—

Gasoline (Wholesale)

New York	gal.	.24	—	—
Boston	gal.	.25	—	—
Pittsburgh	gal.	.26	—	—
Chicago	gal.	.21	—	—
Oklahoma	gal.	.25	—	—
San Francisco	gal.	.20½	—	—

Lubricants

Black, reduced, 29 gravity, 25-30 cold test	gal.	.18	—	.19
Cylinder, light	gal.	.32	—	.33
Cylinder, dark	gal.	.30	—	.31
Paraffine, high viscosity	gal.	.35	—	.36
Paraffine, .903 sp. gr.	gal.	.27	—	.28
Paraffine, .865 sp. gr.	gal.	.19	—	.20

Flotation Oils

(Prices at New York unless otherwise stated)

Pine oil, crude, f.o.b. Florida	gal.	.44	—	—
Pine oil, steam distilled, sp. gr. 0.925-0.940	gal.	.50	—	—
Pine oil, destructively distilled	gal.	.43	—	.53
Pine-tar oil, sp. gr. 1.025-1.035	gal.	.30	—	—
Pine-tar oil, double refined, sp. gr. 0.965-0.990	gal.	.35	—	—
Pine oil, light, sp. gr. 0.950, tank cars, f.o.b. works	gal.	.37	—	—
Pine oil, heavy, sp. gr. 1.025, tank cars, f.o.b. works	gal.	.26	—	—
Pine tar, thin, sp. gr. 1.060-1.080	gal.	.32	—	—
Turpentine, crude, sp. gr. 0.980-1.000	gal.	.40	—	—
Hardwood oil, f.o.b. Michigan, sp. gr. 0.960-0.990	gal.	.21	—	—
Hardwood oil, f.o.b. Michigan, sp. gr. 1.06-1.08	gal.	.19½	—	—
Wood creosote, ref. f.o.b. Florida	gal.	.30½	—	—

Vegetable and Other Oils

China wood oil	lb.	.19½	—	.20½
Cottonseed oil, crude	gal.	1.31	—	—
Linseed oil, raw, cars	gal.	1.25	—	—
Peanut oil, crude	gal.	1.37	—	—
Rosin oil, first run	gal.	.65	—	—
Rosin oil, fourth run	gal.	.66	—	—
Soya bean oil, Manchuria	lb.	.17½	—	.17½
Turpentine, spirits	gal.	.50	—	.51

Miscellaneous Materials

Barytes, floated, white, foreign	ton	40.00	—	50.00
Barytes, floated, white, domestic	ton	30.00	—	36.00
Beeswax, white, pure	lb.	.56	—	.64
Casein	lb.	.22	—	.30
Chalk, light, precipitated, English	lb.	—	—	—
Feldspar	ton	8.00	—	12.00
Fuller's earth, powdered	100 lb.	1.00	—	1.50
Ozokerite, crude, brown	lb.	.65	—	.75
Ozokerite, American, refined, white	lb.	.75	—	1.00
Red lead, dry, carloads	lb.	.10	—	.11½
Rosin, 280 lb.	bbl.	7.20	—	—
Soapstone	ton	10.00	—	12.50
Talc, American, white	ton	15.00	—	22.00
White lead, dry	lb.	.09	—	.10

Refractories, Etc.

(F.O.B. Works)

Chrome brick	net ton	Nominal		
Chrome cement, Grecian	net ton	50.00	—	55.00
Clay brick 1st quality fireclay	per 1000	35.00	—	40.00
Clay brick, second quality	per 1000	30.00	—	35.00
Magnesite, raw	ton	40.00	—	55.00
Magnesite, calcined	ton	55.00	—	90.00
Magnesite brick, Grecian, 9x4½x2½	net ton	135.00	—	140.00
Silica brick	per 1000	50.00	—	60.00

Ferroalloys

Ferrocobalt, 15-18 per cent, carloads, f.o.b. Niagara Falls, N. Y.	ton	160.00	—	—
Ferromanganese, per lb. of Cr.	lb.	.40	—	.45
Ferromanganese, domestic	ton	250.00	—	—
Ferromanganese, English	ton	325.00	—	—
Ferromolybdenum, per lb. of Mo.	lb.	5.00	—	—
Ferrosilicon, 75 per cent, f.o.b. N. Y.	ton	—	—	—
Ferrosilicon, 50 per cent, carloads, del., Pittsburgh	ton	100.00	—	—
Ferrosilicon, 50 per cent, contract	ton	100.00	—	175.00
Ferrotungsten, 75-85 per cent, f.o.b. Pittsburgh	lb.	2.35	—	2.45
Ferroumium, f.o.b. works, per lb. of U.	lb.	7.00	—	—
Ferrovandium, f.o.b. works	lb.	3.50	—	4.50

Ores and Semi-finished Products

Antimony ore, per unit	unit	1.60	—	1.75
Chrome ore, 48 per cent minimum, f.o.b. Cal., per unit	ton	.90	—	.90
Manganese ore, 48 per cent and over, per unit	ton	1.20	—	1.20
Manganese ore, chemical	ton	80.00	—	100.00
Molybdenite, per lb. of MoS ₂	lb.	2.25	—	2.30
Tungsten, Scheelite, per unit of WO ₃	ton	27.00	—	—
Tungsten, Wolframite, per unit of WO ₃	ton	23.00	—	26.00
Uranium oxide, 96%	lb.	3.25	—	3.60
Vanadium Pentoxide, 99%	lb.	10.50	—	—
Pyrites, foreign	unit	.16	—	.16½
Pyrites, domestic	unit	.25	—	.30

INDUSTRIAL

Financial, Construction and Manufacturers' News

New Companies

THE ALLOY FOUNDRY & MACHINE COMPANY, New Rochelle, N. Y. Capital, \$10,000. To operate a plant for the manufacture of castings. Incorporators: Arthur C. Wakeling, Walter E. Wollheim and Gustav C. Pansegrau, New Rochelle.

THE AMALGAMATED CORPORATION, Dover, Del. Capital, \$535,000. To manufacture tools of various kinds.

THE AUTOMATIC SHELL-BORING MUNITIONS COMPANY, Philadelphia, Pa. Capital, \$100,000. To manufacture dynamite, gunpowder and other explosives. Incorporators: Cyrus Hawkins, Samuel Hough and Russell H. Myers, Philadelphia.

THE BARNHARD FERTILIZER COMPANY, Frankfort, Ind. Capital, \$100,000. To engage in the manufacture of fertilizers and kindred products. Incorporators: Clifton W. Cohee, Samuel L. Barnhard and Raymond E. Steward.

THE CAMBRIDGE FOUNDRY & MACHINE COMPANY, Cambridge, Ohio. Capital, \$50,000. To operate a local plant. Mark A. Copeland is the principal incorporator.

THE CENTRAL PIGMENT COMPANY, Dover, Del. Capital, \$250,000. To engage in a general mining business.

THE T. J. COOPER RUBBER COMPANY, INC., Jersey City, N. J. Capital, \$75,000. To manufacture rubber tires. Incorporators: W. Metkiff, J. McLaren and R. Rudolph.

THE COSBY CHEMICAL COMPANY, Chicago, Ill. Capital, \$150,000. To manufacture chemicals and allied products. Incorporators: G. H. and J. I. Childs and John H. Mulligan, Chicago.

THE CRAVIER FOUNDRY COMPANY, INC., Rochester, N. Y. Nominal capital, \$5,000. To operate a local foundry. Incorporators: L. C. Graves, J. T. Cravier and T. Hanlon, Jr., all of Rochester.

THE DETROIT FUEL & FOUNDRY SUPPLY COMPANY, Detroit, Mich. Capital, \$75,000. To engage in the manufacture of foundry supplies, etc. Incorporators: Webster L. Sallee, John T. Hornbrook and Frank I. Cornwall, Detroit.

THE DETROIT MICA COMPANY, Detroit, Mich. Capital, \$10,000. Incorporators: James E. Burgess, C. A. Bromley and C. J. Thorp, Detroit.

THE FORE CHEMICAL WORKS, INC., Jersey City, N. J. Capital, \$475,000. To manufacture chemicals and kindred products. Incorporators: R. E. Breed, M. W. Alexander and U. M. Fleischman, all of Wilmington, Del.

THE FOUR GASOLINE COMPANY, Dover, Del. Capital, \$100,000. To extract gasoline from natural gas, etc.

THE GREAT NORTHERN STEEL & IRON COMPANY, Duluth, Minn. Capital, \$500,000. To engage in the mining, smelting, reducing and refining of metals and the manufacture of iron and steel products. Incorporators: E. C. Kennedy, Frank L. Swan and N. C. Johnston, all of Duluth.

THE DORRITE INSULATION COMPANY, INC., 185-192 Culver Avenue, Jersey City, N. J. has been incorporated with a capital stock of \$200,000. Harry A. Dorr is vice-president; Robert D. Radcliffe, Jr., treasurer, and R. D. Adams, secretary. A large two-story brick building is now being equipped. The factory will be in operation about Feb. 1, 1918. The company proposes to manufacture "Dorrite," an insulating material, which may be molded, stamped or pressed into all special or commercial sizes and shapes for all electrical insulating uses.

THE L. H. BUTCHER COMPANY, New York and San Francisco, has been incorporated under the laws of New York to manufacture and deal in colors, chemicals, minerals and industrial ores. Principal offices, 100 William St., New York. Officers: S. L. Schwartz, president; J. E. Schwartz, vice-president (both of San Francisco); Virgil G. Thomas treasurer and secretary, New York.

THE HIGH SPEED STEEL PRODUCTS CORPORATION, New York. Capital, \$27,500. Incorporators: A. F. McCabe, F. H. Butcher and A. E. Moore, 37 Wall Street.

THE INTERCONTINENTAL PRODUCTS CORPORATION, New York. Nominal capital, \$5,000. To manufacture chemicals, dye-

stuffs and kindred products. Incorporators: D. D. H. Minassian, M. J. Gourland and L. Haim, 253 West Seventy-second Street.

THE INTERNATIONAL NITRO-FIX COMPANY, Wilmington, Del. Capital, \$250,000. To manufacture chemicals, nitrogen compounds, etc. Incorporators: William S. Hilles, La-Penne Guenvuer and R. J. Brenneisen, all of Wilmington.

THE INTERNATIONAL STEEL TUBE & ROLLING MILLS, INC., Cleveland, Ohio. Capital, \$2,500,000. To operate a plant for the manufacture of tubing, etc. Incorporators: O. R. Grimmesey and C. H. Hopkins.

THE JAHANT FOUNDRY & HEATING COMPANY, Akron, Ohio. Capital, \$100,000. To operate a local plant. Incorporators: H. F. McGill, Philip B. Treash, A. H. Cumming, C. Blake McDowell and F. France, Akron.

THE JOHNSON-PYROLIN CORPORATION, Washington, D. C. Capital, \$1,000,000. To manufacture fireproofing and fire-resisting paints, oils, etc. Incorporators: T. G. Brady, J. H. Huston and E. R. Turner, all of Washington.

THE KYUNE COMPANY, Wilmington, Del. To engage in the manufacture of iron products. Incorporators: K. E. Longfield, F. D. Buck and M. L. Harty, all of Wilmington.

THE L. J. LEWERY COMPANY, New York. Capital, \$200,000. To deal in iron and steel products. Incorporators: S. B. Howard, George V. Reilly and A. W. Britton, 65 Cedar Street.

THE LIBERTY METAL PRODUCING COMPANY, Westcliffe, Col. Capital, \$400,000. To conduct a general mining business. Incorporators: Jacob Abelson, D. W. Kahane and I. H. Kuhn.

THE LUMMUS MACHINERY COMPANY, Spartanburg, S. C. Capital, \$10,000. To manufacture machinery of various kinds. Incorporators: J. L. Lummus and Robert E. Carter, Spartanburg, and A. L. Lummus, Saluda, N. C.

THE METALOID COMPANY, Bayonne, N. J. Capital, \$25,000. To manufacture chemicals and allied products. Incorporators: Thomas Brady, Joseph E. Gerry and James Benny, all of Bayonne.

THE MIAMI ZINC & LEAD SYNDICATE, Miami, Okla. Capital, \$5,000,000. To engage in a general smelting and refining business. Incorporators: C. C. Slaughter, Jr., L. P. Gamble, Dallas, Tex.; E. D. Mix, W. H. Logan and D. Rice, Miami, and W. F. Felker and J. E. Felker, Rogers, Ark.

THE NATIONAL BEARINGS COMPANY, Dover, Del. Capital, \$100,000. To manufacture ball bearings, etc. Incorporators: C. L. Rimlinger, M. M. Clancy, Wilmington, and C. M. Egner, Elkton, Md.

THE NEW ENGLAND GRAPHITE COMPANY, Augusta, Me. Capital, \$200,000. To mine for graphite, talc, mica, etc., produce gas, oil and kindred products.

THE PAN-AMERICAN MANGANESE CORPORATION, Dover, Del. Capital, \$3,500,000. To engage in the development of iron and manganese properties.

THE PARAFFINE COMPANIES, INC., Dover, Del. Capital, \$15,500,000. To manufacture paints, paint materials and allied products.

THE PERCHLORATE EXPLOSIVES CORPORATION, Poughkeepsie, N. Y. Capital, \$2,100,000. To manufacture chemicals, explosives, etc. Incorporators: C. W. H. Arnold, L. Bedell and H. B. Vosburg, Poughkeepsie.

THE SAFETY FRAGILE ARTICLE CARRIERS COMPANY, New York. Capital, \$500,000. To manufacture naper boxes, etc. Incorporators: Henry S. Gilbert, John P. Phyllan, New York, and V. T. Casson, Philadelphia, Pa.

IRA L. SLOMON, INC., New York. Capital, \$30,000. To manufacture varnishes, shellac, rubber, etc. Incorporators: S. Moore and M. L. and L. Slomon, 164 East Thirty-fifth Street, New York.

THE SOUTHERN PRODUCING & REFINING COMPANY, Dover, Del. Capital, \$3,000,000. To engage in the production and refining of oil.

THE STANDARD METALS REDUCTION COMPANY, Chicago, Ill. Capital, \$2,000,000. To mine for ores and minerals of all kinds. Incorporators: J. E. Harper, James H. Ayem and T. T. Watson, all of Chicago.

THE STODDARD UNION COMPANY, INC., New York. Capital, \$100,000. To operate foundries. Incorporators: Earl O. Aspdin,

Albert Hild and Frank B. Potterton, New York.

THE TORWILLIGER EQUIPMENT COMPANY, Dover, Del. Capital, \$50,000. To operate a plant for the manufacture of engines, motors, boilers and kindred equipment.

THE UNITED STATES POTASH PRODUCTS COMPANY, White Plains, N. Y. Capital, \$5,500,000. Incorporators: D. T. Connet, White Plains; J. F. Roach and C. E. Bahn, all of New York.

THE UNITED SUGAR COMPANY, Salt Lake City, Utah. Capital, \$1,100,000. To manufacture sugar and all byproducts thereof. Incorporators: F. M. Lyman, Jr., A. J. Gillis, L. C. Wooley, D. P. Thomas and H. A. Strauss, Salt Lake City.

D. A. VANHORNE & COMPANY, INC., Newark, N. J. Capital, \$75,000. To manufacture glassware of all kinds. Incorporators: G. and Edward B. Vanhorne and H. T. Stetson, Newark.

THE VITHUMUS COMPANY, Norfolk, Va. Capital, \$975,000. To operate a plant for the manufacture of fertilizers, etc. Incorporators: R. W. Gamble, R. C. Taylor and George M. Payne.

THE WAY-CLEANSE CORPORATION, New York. Capital, \$5,000,000. To manufacture special machines for the cleaning of streets, railway tracks, etc.

FRED WETZEL & COMPANY, New York. Capital, \$10,000. To manufacture chemicals and kindred products. Incorporators: F. Wetzel, C. and R. Toepfer, 305 West 134th Street.

THE WYOMING SULPHUR & REFINING COMPANY, Chicago, Ill. Capital, \$2,000,000. To manufacture sulphur and chemical products. Incorporators: T. W. Cole, Chicago; K. S. Wilson and M. Luce, Oak Park, Ill.

Construction and Operation

Alabama

ENSLEY.—The National Steel Products Company has acquired property on Eighth Avenue, Bessemer, and plans for the immediate construction of a plant for the manufacture of guard rails, switches, steel castings and allied railroad products. The proposed plant is estimated to cost about \$25,000 and is expected to be ready for operation early in March 1918. R. S. Bohannon is president, and George A. Millar, vice-president.

BIRMINGHAM.—The Tennessee Coal, Iron & Railroad Company is considering the construction of additions to its steel plant at Fairfield, to consist of new plate and angle mills, machine shop, forge and foundry, and other structures to be devoted to the manufacture of machinery and parts for ship construction. A new open-hearth furnace and converter will be installed in the company's plant at Ensley.

MUSCLE SHOALS.—Definite steps have been taken by the United States Government in the construction of its proposed plant at Muscle Shoals, near Sheffield, to be devoted to the manufacture of ammonia, nitric acid and other chemicals employed in the manufacture of explosives. The Government has announced that the cyanamid process of air fixation will be adopted, and for this purpose the American Cyanamid Company has surrendered its process patents, data, chemicals, etc., for the duration of the war. The first unit of the new plant is expected to be completed and ready for operation within the next six months, the entire works involving an expenditure of approximately \$30,000,000. Frank S. Washburn, president of the American Cyanamid Company, will be the chief adviser of the Government in the construction of the new nitrate plant. Power for the operation of the works will be supplied by the Alabama Power Company, which is under a three-year contract with the Government to that end. A new company has been formed to be known as the Air Nitrates Corporation. The officers are Frank S. Washburn, president; K. F. Cooper, vice-president; A. E. Bonn, secretary, and D. E. Hoyce, treasurer. The offices of the company are at 511 Fifth Avenue and 360 Madison Avenue, New York. This company will act as agent of the Ordnance Department in the construction of the new plant. The officers are at the head of the American Cyanamid Co.

Two thousand two hundred acres of land lying at the foot of Muscle Shoals and at the end of the Florence River bridge at South Florence has been selected as the most desirable site, and options have been secured on practically all of the land. The work of laying railway side-tracks has been under way for a week. Several thousand feet have been laid, and the work of laying more track is being rushed.

It is said that when the Government discovered that there was but little nitrate in the country and that great quantities must be had, the situation was viewed with

alarm. The officers and engineers of the American Cyanamid Co. were called upon for help, and at once showed their patriotism by volunteering to help in every way possible, giving their services free of charge in assisting in the building of a great nitrate plant and giving the Government the use of their valuable information.

It is stated that while the great dam is being built, and as soon as the nitrate plant is ready for operation, power to the extent of 30,000 horse-power will be secured from the Alabama Power Co., and that a steam plant to be erected on the site will also furnish 30,000 horse-power.

The entire plant will be so constructed that the power from the Muscle Shoals hydro-electric development may be used as soon as it is ready.

The statement has been made that the great plant will be rushed to completion and that by the first of July munitions from the nitrate will be on the way to France.

The site selected is especially desirable. It lies about 100 feet above the waters of the beautiful Tennessee and has perfect drainage. Railroads extending to the north, south, east and west pass through it, and river transportation may be had to all points down the Tennessee and points on the Ohio and Mississippi rivers.

California

LOS ANGELES.—The United Power Company has acquired property in the San Gabriel Canyon, formerly held by the Electric Power Company, and is planning for the erection of a new power plant at Iron Fork.

McKITTRICK.—The Associated Oil Company is having plans prepared for the installation of a new dehydrating plant on its Delmonte lease in the McKittrick field.

RICHMOND.—Construction has been commenced on a new plant on a site recently acquired from the East Shore Company by the Visayan Refining Company. The property has a deep-water frontage, and the new works will be devoted to the refining of copra.

SAN FRANCISCO.—The Judson Manufacturing Company has taken out a building permit for the construction of extensive additions to its rolling mill, which extends from the foot of Park Avenue to the Oakland line. The company has recently received a number of large contracts, and the additions are to provide for increased capacity.

Connecticut

BRISTOL.—The Bristol Brass Company, Forestville, near Bristol, has commenced the construction of an addition to its plant on Broad Street. The extension will be used for metal reclaiming and allied operations.

WATERBURY.—The Connecticut Brass & Manufacturing Company, a Delaware incorporation, recently perfected to take over the Connecticut Brass Corporation, West Cheshire, and the Pilling Brass Company, Waterbury, has taken out authorization papers to operate in New York. J. C. Lyon, Jr., 61 Broadway, is representative.

Delaware

NEWARK.—A portion of the salicylic acid plant of the duPont Powder Company was destroyed by fire on December 14, with loss said to be about \$100,000.

NEWCASTLE.—Fire on December 6 destroyed a section of the plant of the Wilmington Fibre Specialties Company, which was engaged on Government contracts. The loss is estimated at \$300,000.

NEWCASTLE.—Fire on December 12 destroyed a portion of the shell-loading plant of the Bethlehem Steel Company, near Newcastle, with loss estimated at about \$100,000.

NEWCASTLE.—The Penn-Seaboard Steel Corporation has acquired property adjoining its Baldt works, about 85 acres, and is said to be planning for the construction of a new steel plant.

Florida

JACKSONVILLE.—The Vulcan Iron Works has acquired property on East Bay Street, for a consideration of about \$10,000, and is planning for the construction of a large new plant.

Illinois

CHICAGO.—The Nubian Paint & Varnish Company, LeClaire Avenue, has acquired property adjacent to its works, and is planning for the erection of additions to provide for increased capacity. The property was purchased for a consideration of \$25,000.

CHICAGO.—Swift & Company has completed arrangements for the purchase of a tract of 26,175 acres of land in West Ham-

mond, and is having plans prepared for the construction of a new fertilizing plant to comprise a group of one-story concrete and brick structures. The entire works, when completed, are estimated to cost about \$500,000.

ROCKFORD.—The Rockford Milling Machinery Company is making rapid progress in the construction of a new two-story addition, about 35 x 120 feet, at Harrison Avenue and Eleventh Street, to cost about \$25,000.

E. ST. LOUIS.—The Excelsior Tool & Machine Co. is extending its plant and adding to its foundry. New pattern storage and pattern shop buildings will also be erected. A large core oven and ten-ton and two-ton cranes will be required.

Indiana

LAFAYETTE.—The Barnhard Fertilizer Company, recently incorporated at Frankfort with a capital stock of \$100,000, has acquired the plant and business of William Kalberer, 906 Sycamore Street, and is planning for extensive improvements and alterations. The consideration was \$15,000. S. L. Barnhard is president of the company.

GREENCASTLE.—The American Zinc Products Company, which recently purchased the old Western Tin Plate Mill, has acquired 60 acres of land adjoining the works and is planning for the construction of a new ten-mill plant. The works will give employment to about 500 hands.

MUNCIE.—The Standard Oil Company has acquired property on West Charles Street, and is having plans prepared for the construction of a new three-story brick plant.

Louisiana

CONVENT.—Fire recently destroyed the sugar manufacturing plant of the Louis Himel Planting & Manufacturing Company at its Elysia plantation, with loss estimated at \$100,000.

Maine

PORTLAND.—The Berlin Mills Company has announced that arrangements have been perfected for its consolidation with the Burgess Sulphite Fiber Company, the new organization to be known as the Brown Company. It is planned to increase the capacity of its paper and paper products mills. H. J. Brown is president.

Maryland

BALTIMORE.—Fire recently destroyed a portion of the Mount Winans works of the Maryland Glass Manufacturing Company. It is said the damaged section will be immediately rebuilt.

Massachusetts

BOSTON.—Contract has been awarded by F. E. Atteaux & Company, manufacturers of chemicals, dyestuffs, etc., for the erection of a new two-story reinforced-concrete factory building, about 65 x 170 feet, in South Boston. The Turner Construction Company, Boston, is the contractor.

Michigan

MENOMINEE.—The Menominee Electric Manufacturing Company is taking bids for the erection of four one-story additions to its works to cost about \$60,000.

MUSKEGON.—Rapid progress is being made in the construction of the new plant of the Muskegon Aluminum Foundry Company, Clay Avenue and Ninth Street, and it is expected that the works will be ready for the installation of machinery and equipment within the next three weeks. A. E. Johnson heads the company.

Missouri

ST. LOUIS.—The Pontiac Iron & Land Company is planning for the erection of a pig iron furnace with initial capacity of 40 tons, on property recently acquired in Wayne County. The company owns a tract of about 20,000 acres in this district and plans for extensive operations. J. F. Lindsay, St. Louis; Ira J. Hoover, Waterloo, Ia.; and C. H. Plant, San Antonio, Tex., head the company.

ST. LOUIS.—Fire recently destroyed a portion of the plant of the Liquid Carbonic Company, 3400 Bernard Street, with loss estimated at \$50,000.

New Jersey

JERSEY CITY.—The Interstate Chemical Company, 657 Garfield Avenue, manufacturer of chemicals and allied products, has

taken out a building permit for the construction of a new addition to its plant at 673 Garfield Avenue.

HARRISON.—The E. I. duPont de Nemours Company has announced that effective January 1, 1918, it will discontinue the sale of acids and chemical products of its Harrison works through the National Oil & Supply Company, and will establish a branch for this purpose at 272-78 Passaic Street, Newark.

NEWARK.—The Block Chemical Works has acquired the property of the Berkeley Brick Company, Berkeley Heights, N. J., for a consideration said to be \$25,000, and is planning to use the works as an addition to its plant.

NEWARK.—The United Color & Pigment Company is having plans prepared for the construction of a new three-story brick factory and a new one-story brick power house, to cost \$54,212 and \$10,572, respectively. Percy B. Taylor, Essex Building, is the engineer.

MORRISTOWN.—Charles Butters, of Oakland, Cal., has acquired property consisting of 10 acres at the junction of the Morristown & Erie Railroad and the Malapardis branch, and is planning to commence work immediately on the erection of a new aluminum bronze works.

JERSEY CITY.—The Air Reduction Company has taken out a building permit for the erection of a new one-story steel factory addition to its plant at 171 Pacific Avenue.

BAYONNE.—The Southern Cotton Seed Oil Company, East Twenty-second Street, has had plans prepared for alterations and extensions in its plant to cost about \$8,000.

CAMDEN.—Wilkes, Martin & Wilkes Company, 135 Williams Street, manufacturer of chemicals, has awarded a contract for the construction of two new additions to its plant, one one and two-story, about 110 x 134 and 30 x 100 feet, respectively. J. H. O'Leary, 500 Bloomfield Avenue, Passaic, is the contractor.

IRVINGTON (NEWARK).—The Irvington Varnish and Insulator Company, 213-232 East Speedway Avenue, has taken out a building permit for the erection of a new one-story brick factory, to cost about \$25,000.

NEWARK.—The Block Chemical Works of Newark, N. J., has purchased the Berkeley Brick Company plant, located on the Lackawanna Railroad, at Berkeley Heights, N. J. The principal building is 36 x 308 of brick, steel and concrete construction with a large stack. The purchase was made through the Factory Exchange of New York. The Block Chemical Works is to completely equip this plant and not only require steam-producing machinery, but must provide for their private water supply and the apparatus necessary to produce their chemicals. We understand that their principal product is to be barium chloride.

NEWARK.—The Butterworth-Judson Company, Avenue R, manufacturer of chemicals, is planning for the erection of two new additions to its plant, about 50 x 55 feet, one-story, to cost \$10,000, and a one-story machine and pipe shop, 50 x 90 feet, to cost \$8,000.

NEWARK.—The Eclipse Tanning Company, 119 Sussex Avenue, is having plans prepared for the construction of a new factory building, about 100 x 200 feet, on the southwest corner of Sussex Avenue and Day Street. The structure will cost about \$22,000.

ROOSEVELT.—Fire, on December 4, completely destroyed the nitric acid department of the Armour Fertilizer Works, with loss estimated at about \$20,000. The destroyed portion of the plant will be immediately rebuilt.

SOUTH RIVER.—Fire recently destroyed the plant of the Para Products Company, manufacturer of rubber goods. The destroyed structure was about 100 x 200 feet, and it is said that chemicals used in the manufacture of the company's products were the cause of the blaze.

TRENTON.—The Joseph Stokes Rubber Company, Taylor Street, has awarded a contract to Edward LaRue, 52 South Hermitage Street, for the erection of a one-story addition to its plant.

TRENTON.—The National Carbon Company, 26 West State Street, has filed notice of the dissolution of the company.

Virginia

ALEXANDRIA.—The United States Government, Department of Agriculture, has awarded a contract for the construction of an addition to its chemical laboratory at Arlington Farm, near Rosslyn. Estimated cost of the structure will be \$13,800.

New York

PORT RICHMOND, S. I.—The Standard Oil Company has acquired property on Richmond Avenue, adjoining its plant, and is planning for the erection of additions to provide for increased capacity.

LAUREL HILL, L. I.—The General Chemical Company, Washington Avenue, has awarded a contract for the construction of a new one-story addition to its local laboratory, to cost about \$8,000. Leddy & Moore, 105 West Fortieth Street, New York, are the contractors.

YONKERS.—The National Sugar Refining Company, Main Street, has filed plans for the construction of a new one-story brick addition to its plant, about 44 x 50 feet.

ROCHESTER.—A new one-story concrete and steel foundry addition, about 73 x 80 feet, will be erected by the Gleason Works, University Avenue. The company has taken out a building permit for the structure, which is estimated to cost \$12,000.

BUFFALO.—The National Aniline & Chemical Company, Lee Street, is planning for the immediate construction of a new three-story brick factory building to cost \$88,500.

North Carolina

JAMESTOWN.—The Caroline Pyrites Ore Company, recently organized with a capital of \$100,000, is planning for the operation of its proposed new works at Gardner Hill. The machinery and equipment installation is estimated to cost \$75,000.

Ohio

CARTHAGE.—The Pollak Steel Company has had plans prepared for the construction of two new additions to its plant, comprising a one-story foundry building, about 200 x 300 feet, and new drafting building. Contract for the latter structure has been awarded to the M. Marcus Building Company, Carthage.

MARIETTA.—The Nye Foundry Company has completed arrangements for the removal of its foundry to West Spring Street, Columbus, Ohio, and is planning to double the capacity of the present plant. About 200 hands will be employed at the new location. B. H. Nye is general manager of the company.

SANDUSKY.—The American Crayon Company is considering the acquirement of 10 acres of land in the extreme southeast corner of the city, as a site for its proposed new picric acid plant.

WARREN.—M. A. Garvey and L. J. Garvey, Sharon, are planning for the establishment of a brass foundry in the old Day-Ward plant on North Park Avenue. It is the intention of the company to construct a plant of its own on property now under consideration. M. A. Garvey is manager.

Oklahoma

BARTLESVILLE.—The United States Government has announced that the Bureau of Mines is planning for the construction of one of its experimental stations for the investigation of problems relating to the petroleum and natural gas industries, on a local site.

Pennsylvania

HEIDELBERG.—Fire recently destroyed a portion of the plant of the Etna Chemical Company at Heidelberg, near Pittsburgh, with loss estimated at \$250,000. The fire was caused by an explosion, the plant being engaged in the manufacture of T.N.T.

KITTANNING.—Plans are being made by the Carbon Steel Company for the erection of two open-hearth furnaces on a site now under consideration, each furnace to have a capacity of about 100 tons of pig billets daily. This company recently acquired the property of the Kittanning Iron & Steel Company.

LEBANON.—The Lebanon Blast Furnaces, operated by the E. J. Lavino Company, have suspended operations for relining and improvements, and it is expected that the work will be completed by the first of the year. These furnaces are devoted to the production of ferromanganese.

PHILADELPHIA.—The Gorgas & Pierre Manufacturing Company, 144 East Allen Street, manufacturer of oils, etc., has awarded a contract for the construction of a new three-story concrete addition to its plant, about 75 x 156 feet to cost \$50,000. The Turner Concrete Steel Company, 1713 Sansom Street, Philadelphia, is the contractor.

PITTSBURGH.—Extensive alterations and improvements are being made in the plant of M. Streng's Sons Company, 1300-46 River Avenue, and the company is also planning for the construction of a new addition in which furnaces will be installed for the reclaiming of metals.

CANONSBURG.—E. W. Edwards and associates, Cincinnati, Ohio, have taken over the plant of the Canonsburg Steel & Iron Works, and are planning for extensive additions to increase the capacity. The consideration is to be about \$600,000.

MONONGAHELA CITY.—The Monongahela Steel & Iron Company is perfecting arrangements for the construction of a new 36-furnace plant in Paden City, W. Va. Thomas Watson, Pittsburgh, is secretary and treasurer for the company.

ST. MARY'S.—The Speer Carbon Company and the Stackpole Carbon Company are each installing two branches with vertical retorts for calcining petroleum coke. The Russell Engineering Company of St. Louis is making the installations.

Tennessee

KNOXVILLE.—Construction of extensive additions to the plant of W. J. Oliver Company are being rushed to completion. New machinery has been ordered and will cost about \$250,000. The plant is specializing in the production of six-inch shells for the Government, and will have a capacity of 1500 shells daily.

NASHVILLE.—It has been reported that the du Ponts are planning the establishment of a million dollar explosive plant near Nashville, 2500 acres having been bought for a site. The report has not been verified by the du Pont Co.

Texas

BROWNWOOD.—The Gotebo Oil & Refining Company has commenced the construction of a large new local refinery on a site just south of the city. It is expected that the first unit of the plan will be completed and ready for operation within thirty days.

Utah

HONEYVILLE.—The Utah-Idaho Sugar Company has acquired a tract of 120 acres of land and is reported to be planning for the construction of a large new sugar plant.

SALT LAKE CITY.—The Utah Oil Refining Company is planning for the construction of extensive additions to its plant, to include a new paraffine works to cost \$50,000; new tank to have a capacity of 1,500,000 gal. to cost \$35,000, and the doubling of the present capacity of the power house. Headquarters of the company are at Fourth Street West and Ninth Street North. J. C. Howard is general manager.

SALT LAKE CITY.—The Cedar Butte Oil Company is having plans prepared for the erection of a large reduction plant at its oil properties at Whiterocks.

Washington

SEATTLE.—The Alaska Gastineau Mining Company, Juneau, Alaska, has announced that a large new steel plant will be constructed on the Puget Sound which will involve an expenditure of approximately \$25,000,000. The first unit of the plant will require an investment of \$9,000,000, and work will be started on the plant within 90 days. Mr. Bart L. Thane is general manager of the company. W. H. Crocker, H. Fleischhacker, and S. F. B. Morse, San Francisco, Cal., are also interested in the project.

SEATTLE.—The Seattle Smelting Co., Inc., has completed its plant and is now producing ferromanganese. One three-phase unit capable of producing six tons of alloy per day has been installed and others ordered. Other ferroalloys may be produced later.

West Virginia

WHEELING.—The Superior Glass Manufacturing Company has recently completed the erection of a new addition to its plant to provide for increased capacity. The works were formerly occupied by the Haskins Glass Company, and when acquired by the Superior company, extensive improvements were made.

HUNTINGTON.—The Huntington Steel Products Company, specializing in the manufacture of munitions, is planning to increase the capacity of its plant.

HUNTINGTON.—L. H. DePaul, Foxboro, Mass., and associates are considering the erection of a large new local chemical plant, to be devoted to the manufacture of salicylic acid from sawdust.

Wisconsin

MADISON.—Fire recently destroyed a portion of the plant of the Southern Foundry Company, with loss estimated at \$50,000. The company was engaged in the manufacture of materials for munition plants.

MILWAUKEE.—The George H. Smith Steel Casting Company, 500 Clinton Street, is making rapid progress in the construction of a large new addition to its foundry.

MILWAUKEE.—The new plant of the General Steel Company near lake shore has commenced partial operations. The works consist of a large machine shop, mill building, storage building, and smaller shop structures, and the remainder of the machinery is now being installed. It is expected that the plant will run at full capacity within thirty days. The product of the works will be a high-grade electric steel. Harry Weidenthal is superintendent.

Manufacturers' Catalogs

E. I. DUPONT DE NEMOURS & COMPANY, together with its associates—the DuPont Fabrikoid Co., DuPont Chemical Works, the Arlington Company and Harrisona, Inc.—have issued a new products book, listing all the products of the above concerns and describing their uses. The head offices of the company are at Wilmington, Del.

THE BARRETT COMPANY, 17 Battery Place, New York City, has issued a new booklet on the source, production and use of sulphate of ammonia.

TATE-JONES & COMPANY, Pittsburgh, Pa., has issued Bulletin No. 160, giving a complete description of its recuperative gas-oven furnaces for the heat-treatment of steel.

CONDENSITE COMPANY OF AMERICA, Bloomfield, N. J., has issued a new booklet, describing its various molding preparations and other phenolic condensation products.

LINK BELT COMPANY, Chicago, Ill., has issued a new bulletin entitled "The Ideal Drive for Clay Working Machines," giving many illustrations of the uses of link belts.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, East Pittsburgh, Pa., has issued Catalog 30, covering the company's complete line of direct-current motors and generators for industrial service.

Other New Publications

DETERMINATION OF MOISTURE IN COKE. A. C. Fieldner and W. A. Selvig. A bureau of mines technical paper, No. 148. Obtainable from the Bureau of Mines, Washington, D. C.

GOLD, SILVER, COPPER AND LEAD IN SOUTH DAKOTA AND WYOMING, in 1916. By Charles W. Henderson. U. S. Geological Survey report obtainable from the U. S. Geological Survey, Washington, D. C.

ANNUAL REPORT OF DIRECTOR OF BUREAU OF MINES, for year ending June, 1917, issued by Bureau of Mines, Washington, D. C.

Manufacturers' Notes

THE AMERICAN CHEMICAL & OZOKERITE CO. has removed its Chicago offices to 7323 Woodlawn Avenue, where the manufacturing plant is located.

THE RAYMOND BROS. IMPACT PULVERIZER CO., of Chicago has appointed the Dry Milling Engineering Co., 202 Boston Building, Denver, Col., western agents for its pulverizing machinery. The latter concern is headed by William B. Senseman and it will also represent the Buckeye Dryer Co., London, Ohio, the Dust Recovering & Conveying Co. of Cleveland and the Quigley Furnace Specialties Co. of New York. Mr. Senseman has been connected with Raymond Bros. for the past eight years. The Dry Milling Engineering Co. is a newly incorporated concern.

THE JONATHAN BARTLEY CRUCIBLE CO. of Trenton, N. J., manufacturers of crucibles and retorts, has engaged F. P. Welton of Stamford, Conn., to represent them in New England and Canada.

THE DIAMOND POWER SPECIALTY COMPANY of Detroit, Mich., is planning to market on a large scale a calorized metal, known as insuluminum, a description of which was given in our issue of Oct. 15, 1916, p. 498. A large plant has been built for its manufacture for such uses as scot blowers, superheater tubes, carbonizing boxes, annealing boxes, etc.

GANNESTAD & JACOBSEN, engineers, have moved their Pittsburgh headquarters to the B. F. Jones Building, where larger quarters are available. The firm is engaged in the designing of iron and steel and other industrial plants and special machinery.